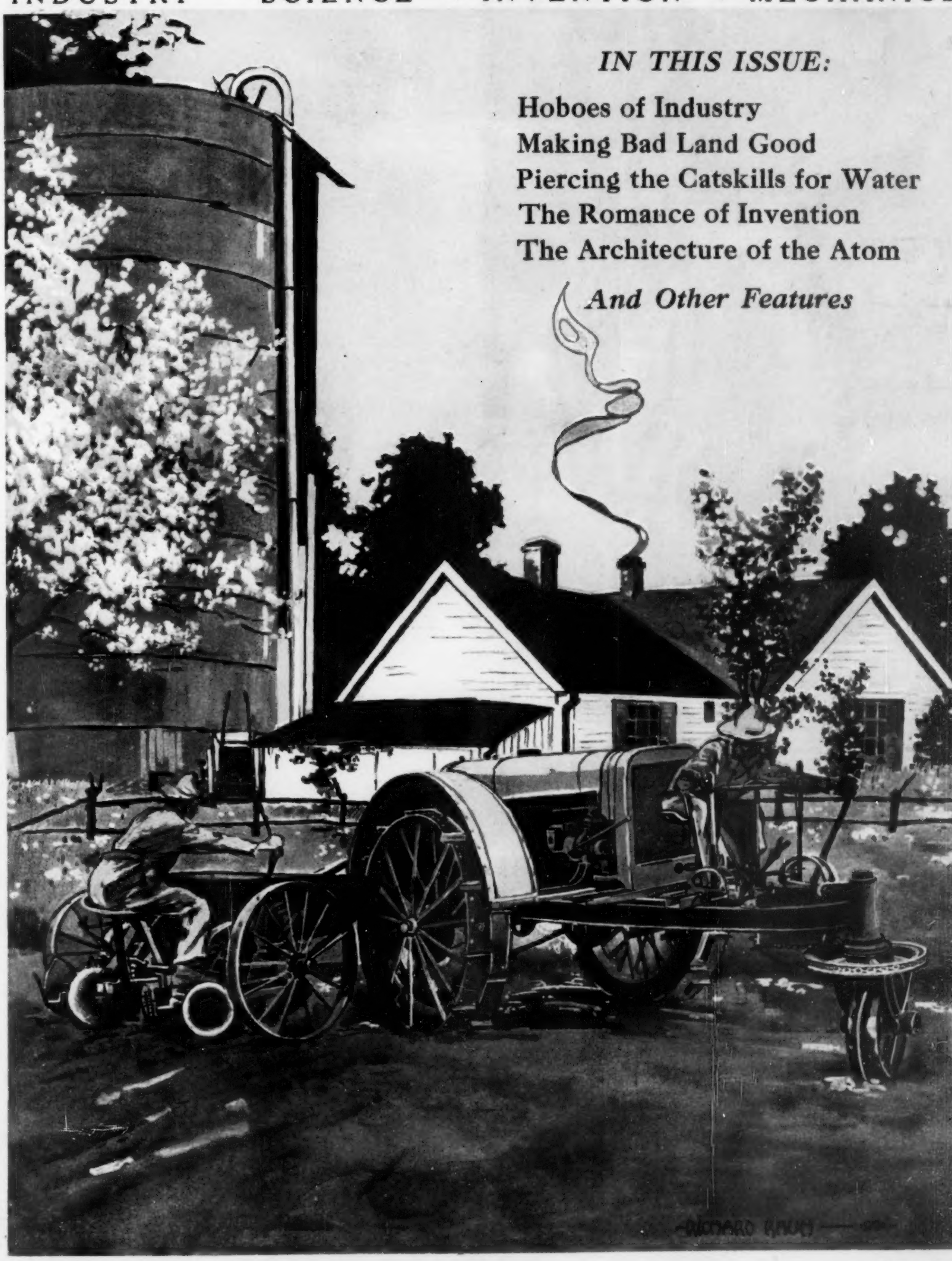
SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



STARTING OUT FOR THE DAY'S WORK IN THE FIELDS.— (See page 542)

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Mobiloils

Power speaks all languages

How American Supremacy in Scientific Lubrication has made its way around the globe

A USER of Gargoyle Mobiloils motored around the world. Writing after 18,000 miles of running through the countries of the earth, he said:

"I believe that if American motorists realized that Gargoyle Mobiloils can be obtained in practically every country of the globe as easily as they can be secured in the United States, foreign touring would be much more common."

This man bought Gargoyle Mobiloils in Dublin. He found them in every part of Ireland. He saw the red Gargoyle all over England and Scotland.

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He secured Gargoyle Mobiloils in Chateauroux, Limoges and the old Roman town of Carcassonne, which materially helped his climb over the Pyrenees the following day.

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This widespread use of Gargoyle Mobiloils for the lubrication of automobiles, tractors, motor trucks and motor-cycles, is not a sudden growth. The world-wide standing of the Vacuum Oil Company is simply the result of its ability to perform. Every automobilist understands the language of the red Gargoyle. Every experienced motorist appreciates full power and high efficiency.

Nothing counts like *engine results*.

Gargoyle Mobiloils *deliver engine results*—full power, full protection, smooth running—all on lower consumption of oil and fuel.

The grade specified for your car in the Chart will show you new *engine results*. Try it.

GARGOYLE

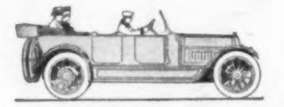
Mobiloils

A grade for each type of motor

DOMESTIC BRANCHES

New York	Philadelphia	Detroit	Minneapolis	Kansas City, Kan.
Boston	Pittsburgh	Chicago	Indianapolis	Des Moines

VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* NEW YORK, U.S.A.



Correct

AUTOMOBILE LUBRICATION

GARGOYLE

Mobiloils

A grade for each type of motor

Gargoyle Mobiloils for engine lubrcation are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in this partial Chart, send for booklet, "Correct Lubrication" which lists the correct grades for *all* cars.

AUTOMOBILES	[illegible]		[illegible]		1917 Models		[illegible]		[illegible]	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-38)					A	Arc	A	Arc		
" (6-39B) Teetor-H			A	Arc						
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
Case	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Chalmers			A	A			Arc	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-30)	A	A			A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A				
" (F A.)	A	Arc	A	Arc						
Cole							Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Cunningham									Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Dart	Arc	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Model C)					A	Arc	A	Arc	A	Arc
" (2 and 3½ ton)	A	A	A	A						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-X)			A	A	A	A				
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Com'l	Arc	Arc								
" " (Model 12)	A	Arc								
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Hudson							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	A		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
King									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Model 48)							A	A	A	A
" " (12 cyl.)			A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lippard Stewart			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. M)					A	Arc	A	Arc		
" " (Mod. MW)					A	Arc				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	A	A	Arc
McLaughlin	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
McLaughlin (Mod. E63)	A	A	A	A						
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
" (22-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	A	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M4)			A	A	A	A				
" (Mod. S)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	A	Arc	A	Arc						
" (Mod. 671)			A	A						
" (Quad)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Nelson	A	A	A	A	A	A				
Oakland	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A		
Oldsmobile (4 cyl.)	A	Arc					Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-36)							A	Arc	A	Arc
" (6-38-39)					A	Arc				
" (6-40)	A	Arc	A	Arc						
Paige (Com'l)	Arc	Arc	Arc	Arc						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	Arc	Arc
" " Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	Arc	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A	Arc	Arc
Renault (French)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Riker	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (¾ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (2 & 3½ ton)	Arc	Arc	Arc	Arc						
" (¾ ton)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Sixteen Valve)	A	A	A	A	A	A				
White (5 ton)	A	A	Arc	Arc						
Willys-Knight	B	A	B	A	A	A	B	A	B	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

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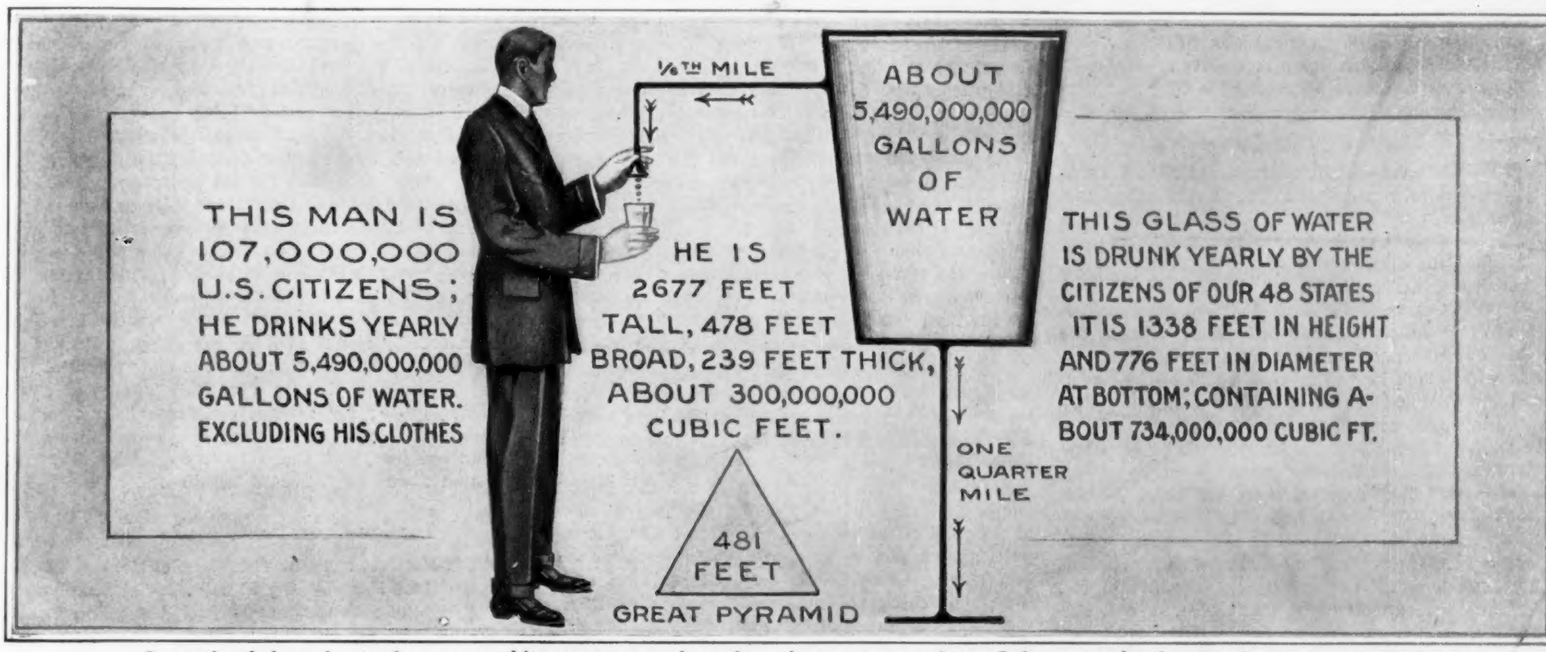

Our national glass of water for a year and its consumer are here shown in proper proportions. Is it any wonder that Americans are recognized the world over as great water drinkers?

How Much Water Do We Drink in the United States?

SINCE the hour when alcohol, as a beverage, was banished from this country, the amount of water which is drunk annually in the United States must have greatly increased. Even with this great increase in water drinking, however, it is doubtful if most of us drink enough water. It is, unfortunately, a fact that some of us do not drink enough water until the doctor advises us to do so—when, often, it is too late.

Nevertheless, there is a large amount of water drunk in this country, and a careful consideration indicates that the daily amount averages, approximately, three glasses, for each individual. These three glasses do not include the water that we take in as part of our solid food, or the water contained in milk, coffee and other beverages, all of which naturally diminish the amount of water which each individual drinks directly. Of course we drink more water in summer than in winter, and more when we are subject to violent physical exertion than when leading a quiet, sedentary existence; but a careful consideration indicates that the daily amount averages, all the year round, about three glasses for every man, woman and child in the United States.

Inasmuch as the total daily consumption, for every purpose, in New York City, approximates 660,000,000 gallons, and inasmuch as the city's population is, at present, about 6,100,000, it is evident that the citizens of New York drink daily about 858,000 gallons of water, or less than 1/770th of the amount which is used every 24 hours. If the population of our 48 states equals 107,000,000, then these 107,000,000 people are drinking daily at least 15,000,000 gallons of water, and annually more than 5,475,000,000 gallons. That is, the average citizen imbibes yearly about 205 quarts, or 51 gallons. Now, if a gallon contains 231 cubic inches, then 51 gallons contain 11,781 cubic inches, or nearly 7 cubic feet. So it is evident that the average human being in this country drinks annually more than his own bulk of water. In other words, since a gallon of water weighs about 8¼ pounds, the average citizen of the United States imbibes yearly about 425 pounds, or more than 1/5th of a ton, of "Adam's Ale."—By *Charles Nevers Holmes.*

Scientific American Monthly for May

SIXTEEN years ago, Sir Charles A. Parsons proposed that a shaft be sunk into the earth to a depth of twelve miles with the idea of exploring the regions beneath us. It was estimated then that it would take eighty years to sink such a shaft. With the improved machinery and methods of today it seems reasonable to estimate that the shaft could be sunk in thirty years. When we consider that the deepest well hole so far sunk penetrates to a depth of only a mile and a half and our deepest mine shaft to only a mile and a fifth, the value of the proposed exploration may be appreciated. In his article on *Researches at High Temperatures and Pressures*, Sir Parsons discusses methods of overcoming the extreme heat that would be developed at such a depth, and then he goes on to review the limits of pressure and temperature which are artificially obtainable and to make some comparisons between them and the pressures and temperatures occurring in Nature.

Are there other stellar systems similar to our own? This question is discussed by Harlow Shapley, who reviews the evidence favoring and unfavorable to the "island universe" hypothesis. He arrives at the conclusion that globular clusters, Magellanic clouds, spiral-nebulæ, etc., cannot maintain their claims to galactic structure and dimensions, but, on the other hand, we have no evidence that somewhere in space there are not other galaxies.

Had the railways of the United States in 1918 been completely electrified along lines fully tried out and proved successful today, 122,500,000 tons of coal or more than two-thirds the coal now burned in our 63,000 steam engines would have been saved. Such is the astonishing statement of A. H. Armstrong in the article on the *Last Stand of the Reciprocating Steam Engine*, which draws a startling and most illuminating picture of the inefficiency of the steam locomotive.

During the emergency of the war the Navy Department was suddenly confronted with the necessity of arming all transports, supply boats, sub-chasers and tugs in order to protect the transport of men and materials across the ocean and prepare for German marauders on our own coasts. This called for an enormous expansion of ordnance manufacture. One of the important results of this emergency expansion was the development of the high-temperature electric heat-treating furnace. This is described at considerable length by George H. Holden, Ordnance Inspector.

The study of yeast has been occupying men of science in various countries during recent years. The results of some of these researches have already been laid before readers of the SCIENTIFIC AMERICAN. They are supplemented by the article entitled *Fresh Information Concerning Yeast.* It describes the German researches into yeast grown from inorganic substances, showing that while this work was successful in the laboratory it is as yet a failure economically. It also describes the more practical work of a group of chemists at the Mellon Institute who have succeeded in bettering the quality and also lowering the cost of bread by means of mineral nutrients for the yeast plant.

It is high time that the American public awoke to the value of the cocoanut tree. It yields no less than eighty-four different products ranging from a delicious vegetable to roofing material and from a piquant pickle to a filling for gas masks. In the article on *Cutting the Cocoanut Cake*, May Tevis describes the various products of this tree, the manner in which the tree is grown and its commercial import.

Professor Wilder D. Bancroft, of Cornell University, writing under the title *Blue Eyes and Blue Feathers*, explains the nature of color and the difference between the colors which are due to physical structure and those due to pigments.

The May issue of the SCIENTIFIC AMERICAN MONTHLY contains twenty-two leading articles in addition to a large number of shorter items and the usual departments of notes and abstracts.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Beclouding the Issue

THE Congressional investigation of the criticisms of the first four months of our naval coöperation in the war, as made by Admiral Sims in a private letter to the Secretary, has developed very much along the lines which we had expected. Taken by and large, the testimony of the line officers who fought the war upon the high seas has been an endorsement of Admiral Sims's criticisms; whereas the defense of Secretary Daniels and the group of bureau chiefs with which he has surrounded himself has followed the expected course of beclouding the issue by dealing in vague generalities.

In what way have Mr. Daniels and the faithful few in Washington beclouded the issue? First, by giving the impression that Admiral Sims had criticized the whole conduct of the war from the time we entered until the signing of the armistice; and, second, by conveying the impression that not only was such criticism undeserved, but that any criticism whatsoever of the Navy was as unpatriotic as it was unjust. We do not say that these charges were made categorically, but we do say that the testimony of Mr. Daniels and his bureau chiefs has tended to discredit Admiral Sims in the eyes of the lay public, by suggesting that this gallant officer had cast a slur upon the Navy to which he belongs by criticizing its record throughout the whole eighteen months of the war. Whether this result was intended we do not know, but this we do know—that by throwing so much dust in the air in the endeavor to becloud the real issue, a gross injustice has been done to one of the truest-hearted, most hard-working and most brilliant officers that ever brought honor and credit to the United States Navy.

As a matter of fact—and Secretary Daniels knows this just as well as we do—Admiral Sims's criticisms were aimed at the amazing and baffling delay and lack of aggressive action which marked the first three months of the war—for the work of the Navy both in the Department at Washington and on the high seas after those first few months of hesitation, Admiral Sims has nothing but the very highest praise. Of this fact, his written and spoken words bear abundant proof.

The Admiral's letter was a letter of constructive criticism addressed to the Secretary and intended for the most secret archives of the Department. That the existence of such a letter became known to the public is largely the fault of the Secretary himself, and that it was read before the Committee is not in any sense chargeable to Admiral Sims, but to the Chairman of the Committee before whom the Admiral was giving testimony—and the Chairman, by the way, has publicly accepted full responsibility for the reading of the letter. It is the duty of officers of the Navy to write such letters of constructive criticism; they come into the Department all the time, and it is the privilege even of the youngest ensign to send in a letter of this kind, if he thinks he has criticisms or suggestions to offer, which may add to the sum total of technical information in the Department files and serve to promote the interests of the Navy as a whole.

There has always been a large body of men in the Navy who, thank Heaven, believe that our Navy is never so good but that it can be greatly improved, and among these Admiral Sims has always been conspicuous. He believes that a navy thrives best in a bracing atmosphere of friendly, helpful criticism, and that nothing is so hurtful to its progress as the atmosphere of everlasting and overdone adulation with which a secretary of strongly political instincts is prone to surround his navy.

That the Navy was ill-balanced and in no condition immediately to enter a great war was well known and universally admitted by the officers of the Navy in the period 1913-1914. When Admiral (then Captain) Sims bent every effort to awaken the nation to our state of unpreparedness, it was largely in answer to this appeal that the SCIENTIFIC AMERICAN wrote a series of ten articles under the caption "The Needs of the United States Navy," which appeared in the spring of 1914 and therefore only a few months before the war. Secretary Daniels not only gave the editor every facility to acquire the necessary data as to our unpreparedness, but he himself crowned his approbation by contributing one of the articles. Now, the remarkable facts which we wish to bring out are that the most stringent of the Admiral's criticisms were mild compared to the facts as to our unpreparedness which were revealed in that series of articles; and that such criticisms as he made of our first four months of participation in the war show that what did happen was about what we predicted would happen, when we were disclosing the needs of the Navy early in 1914.

We are writing this in the interests of truth and justice and in the hope that it may serve to blow away the dust of ungenerous innuendo and misrepresentation with which the real issue has been beclouded and the record of a brilliant and highly patriotic naval officer besmirched.

Let us get this thing straight; for the facts are simple and they are of record. For several months at the most critical period of the naval war, America's participation was confined to a single executive representative in London, with only one assistant to help him; and the repeated, urgent recommendations of this representative that our Navy Department get into the war at once by sending every possible destroyer and anti-submarine craft to the theater of operations, were either refused or ignored.

Would it not be advisable for the Secretary to stop making smoke screens and get down to the business of explaining this most amazing situation?

Progress of Our Merchant Marine

IF ever there was a great national enterprise that called for enthusiastic support it is that of giving the flag of the United States Merchant Marine its proper place on all the ocean highways and at all the trading ports of the world. Despite initial errors, due largely to the great rush of wartime construction, we have today a large and growing fleet of serviceable ships in which the nation may take a just pride. Nor must we allow the many mishaps which have occurred to our earliest ships, built by inexperienced gangs of workers, to shake our confidence in the fleet as a whole. The "lame ducks" are being strengthened and re-riveted or passed out of the service, and the bulk of the new fleet is well built, has received the highest rating, and is good for any service on the high seas.

At the recent Atlantic City conference, W. F. Taylor, Assistant Director of Operations of the Shipping Board, gave these statistics of world shipping and of American shipping in particular: In 1914 the total world tonnage amounted to over 45,000,000 gross tons, of which 18,000,000 gross tons was owned by Great Britain. He tells us that war and marine losses of 14,000,000 gross tons were more than made up by wartime construction, so that in June, 1919, world tonnage had increased to 47,500,000 gross tons.

The bulk of the wartime construction was due to our own effort; for, whereas in 1914 America had only 1,137,300 gross tons in foreign trade, on March 1st of this year, the Shipping Board fleet consisted of 1,680 vessels of 6,100,000 gross tons, of which 4,300,000 tons were steel cargo steamers. Also, on that date we were building or had under contract an additional 2,000,000 gross tons of deep-sea shipping.

As to the future, we need have no anxiety as to whether there is room in the deep-sea trade for our large and rapidly growing fleet. According to Lloyd's register, notwithstanding the increase of 2,500,000 gross tons over the total of 1914, there is an actual shortage of world tonnage of not less than 8,500,000 tons gross. This shortage is arrived at by making due allowances for the normal annual increase, for normal replacement, for relative loss of world tonnage due to indifferent emergency construction, for slow turn arounds because of congested ports, for labor troubles and longer voyages, to say nothing of a decrease of over a million tons of sailing vessels.

Let it be understood that our new fleet is very actively at work. Mr. Taylor tells us that the Shipping Board on March 1st had established 181 regular shipping lines connecting American ports with practically all the primary and many of the secondary markets of the world. On these routes are employed 515 steamers of 2,700,000 gross tons, or nearly one-half of our fleet, the other half being engaged in miscellaneous services. All of these operations have been carried out through private American shipping concerns acting as agents for the Shipping Board. The Assistant Director of Operations believes that the 160 agents will show themselves fully competent to carry on successfully under private ownership and operation, which should be our goal of permanent achievement to be reached within the shortest practical time. But, if we are to expect any real accomplishment in foreign commerce by means of American shipping lines, there is one piece of legislation which is more essential than any other, and that is a ratified Treaty of Peace. Obviously so; for foreign commerce is a two-party transaction, involving in every case some other nation than our own, and therefore it cannot possibly exist behind a wall of "splendid isolation."

London-Cairo-the Cape, by Airplane

THE recent flight from London to the Cape of Good Hope by way of Cairo, a distance, over the route followed, of nearly 10,000 miles, is comparable with the 12,000-mile flight which was recently made from London to Australia, and, like the preceding venture, it has brought its full measure of useful scientific and technical data. Colonel Van Rynevelt and Captain Brand, of the South African Air Service, left London in a Vickers-Vimy on February 4th, and traveled by way of Rome and Sollum, on the African coast, to Cairo. Leaving Cairo on February 10th for a non-stop to Khartoum, they crashed when about half-way over the desert at Wadi Halfa, and the plane was hopelessly wrecked. They salved their engines and returned to Cairo, where they placed them in a sister machine and made another start. Again they came down in the treacherous air at Wadi Halfa, but struggled through to Khartoum. Victoria Nyanza was reached February 26th, Victoria Falls on the Zambezi on March 2nd, and Buluwayo on March 5th. Leaving Buluwayo, their machine failed to rise properly and crashed. The South African Government sent north a Royal Air Force Factory Vickers machine, and on this they left Buluwayo on March 17th and reached Cape Town on March 20th.

The lessons of this extraordinary fight with the elements are, first, that the airplane is no mere fair-weather craft, but is capable of winning through against abnormally severe obstructions. One of the competing craft had no less than eight forced landings in a strange country, in spite of which it was able to carry on. We quite agree with *Land and Water* that aircraft manufacturers must cut loose from some war conceptions; that just as the battleship would make a poor merchantman, the battle plane should be the foundation rather than the model of the commercial plane; and, finally, that it is necessary to chart the air as the sea has been charted. There are areas of dangerous and stormy air as there are of dangerous and stormy sea. Hot, dry air was the cause of forced descents and of failures to rise, and areas of this character must be carefully charted before regular overland travel can be achieved with safety and on schedule time.

Engineering

A Billion Dollars for Road Work.—According to figures compiled by the Portland Cement Association and recently published in *Engineering News-Record*, a summary of state and county bond issues for road-building purposes as of March 1st, 1920, indicates that there was authorized during 1919 and so far in 1920, $635,641,729. For the remaining months of 1920, elections in the states and counties of the states are to be held which will determine whether an additional $391,253,800 is to be appropriated for road-building purposes. Therefore, the total, including the amount of money authorized and proposed, is $1,026,895,529.

A Tie Renewal Record.—Renewals of ties on the Delaware, Lackawanna and Western Railroad have never been more than 10.2 per cent of the total ties in track for any one year since 1900. In a table giving the record in a committee report presented at a recent meeting of the American Wood Preservers Association, there are four years when the percentage was 10 per cent or slightly more. Considerably more than half of the renewals since 1910 have been made with treated ties, until at the end of 1918 there were 3,348,765 treated ties, out of the total 10,524,129 ties, inserted for renewals since 1900 in 2,671 miles of main and side tracks.

Reconstruction in Belgium.—The Belgian public is much interested at present in the question of the reconstruction of the devastated region in West Flanders. Much of the delay to date has without doubt been due to uncertainty as to the exact program to be followed. There has been a popular demand that the two ruined cities of Ypres and Dixmude be left as they are, as a monument to those who lost their lives in the neighborhood, but this proposition has been opposed by the former inhabitants of the area, who desire to have their property restored. This has been particularly true of the former citizens of Ypres (population before the war, 18,000), who are returning in some numbers and starting to rebuild. The Government has decided therefore to take the matter in hand, and rebuild the entire city of Ypres, leaving none of the ruins except the Cloth Hall, the Cathedral, and the Cloister, which are to serve as monuments.

Standardized Factory Buildings.—Many of our leading industries whose modern plants are noted as the last word in factory design and construction have turned to the standardized factory construction. These buildings are fabricated at some center point and shipped to the place where they are to be used, in sections. The sections are rapidly assembled into complete buildings with a minimum of labor, time and expense. Indeed, the standardized factory buildings cost less than any other type of permanent construction. Fire-proof, long-lived, affording maximum daylight, flexible in size and shape, they are used for factories, warehouses, machine shops, founderies, tool rooms, multiple garages, cafeteria, and so on. Built from interchangeable steel panels, they can be enlarged, rearranged or re-erected without loss. They are furnished in any type of hip, monitor or saw-tooth roof, in any length, various heights, and widths up to 100 feet.

Light-Colored Paint for the finishing coat on steel structures, on the score of efficiency and appearance, was advocated at the annual meeting of the American Railway Bridge and Building Association by J. R. Shean, of the Pacific Electric Railway, Los Angeles. Unless the price of material is the main consideration, he sees no reason why steelwork should not be painted in light colors, since their resistance to heat rays, as compared with dark colors, would be easier on the oil film which holds the pigments together. Canary yellow, pearl gray or light olive green will change an unsightly black structure to one that will be at least more in harmony with the surroundings. These light colors, Mr. Shean says, will have a sufficiently longer life than the dark colors to pay for any difference in cost. It may be argued that light colors become unsightly in a short time from dirt and smoke. This cannot be noticed to any extent, he thinks, except overhead on through truss bridges and on overhead bridges; but even with black paint the smoke marks show conspicuously here.

Astronomy

A Double Star with Wide Separation.—Dr. Robert Trumpler reports that in determining the parallax of the sixth-magnitude star B.D. +7 deg. 2960, he found that a tenth-magnitude star more than eight minutes of arc distant from it has the same large proper motion and the same parallax. Undoubtedly the two stars are physically connected, though the distance between them amounts to no less than 13,200 astronomical units. If it be assumed that the two stars revolve about a common center in a circular orbit, a single revolution would require hundreds of thousands of years.

The Origin of Lunar Craters.—A very plausible and interesting suggestion on this subject is embodied in an article by Dr. Herbert E. Ives, the well-known physicist, in the *Astrophysical Journal*. The writer presents some photographs taken from an airplane over Langley Field, showing craters produced by bombs dropped by aviators. These holes reproduce in a striking manner the appearance of lunar craters, including the circular wall, central peaks, and short radiating streaks. Dr. Ives points out that the serious objections which have heretofore been raised to the idea that lunar craters were produced by the impact of meteors do not apply if we regard the meteor not merely as a projectile but as an explosive bomb. That the impact of the meteor on the surface of the moon would, in fact, produce a violent explosion appears to follow from a simple calculation of the heat generated in the process. Not only does this explanation take care of the general appearance of the craters, but it affords an answer to the perplexing question presented by the almost uniformly circular shape of the lunar craters; for the symmetrical form would result from an explosion regardless of the angle at which the meteor struck. As to the objection that the earth does not show similar effects of bombardment, if we disregard the unique case of Cañon Diablo, "the most complete answer is found by noting, first, that the earth is surrounded by an atmosphere which in previous ages must have been much denser than now and so would dissipate the energy of falling meteors, as indeed we see it doing now; and, second, that the earth's surface has been undergoing the processes of upheaval and weathering for perhaps countless ages since the collision with the giant meteor swarms which permanently marked the dead and atmosphereless lunar surface."

Variable Star Observations.—The last report of the Committee on Variable Star Observations of the American Astronomical Society states that the work of American and British observers in this line has increased steadily, so that now many of the long period, a few short period, and several irregular variables have been very thoroughly and carefully followed. Observers in the southern hemisphere are now following the southern variables almost as completely as the northern observers are covering the northern sky. The aid of several of the largest telescopes in the United States has proved of great help in giving better determinations of the minima of the fainter variables. A striking example of the efficiency of the variable star organizations was furnished in the case of the recent bright nova in Aquila. Results on this star were obtained from 250 observers, located in nearly all parts of the world, and more than 6,000 observations were made during the seven months following its apparition. In a recent Harvard College Observatory Circular, Mr. Leon Campbell gives a table of predicted maxima in 1920 of the long-period variables for which fairly regular periods have been determined. He states that these maxima can be predicted with a fair degree of certainty because of the continually increasing value of the observations which are now received at Harvard from outside as well as local observers, including many in foreign countries. The American Association of Variable Star Observers is engaged in efforts to secure as many telescopes as possible for lending to members of the association who will use them to good advantage in this work. Several, ranging in size up to a six-inch refractor, have already been lent. Anybody who knows of good telescopes not now in use that might be available for this purpose should communicate with Miss Annie J. Cannon, Harvard College Observatory, Cambridge, Mass. The membership of the association is now 160.

Automobile

Tires Cut More Easily in Wet Weather.—Wet rubber cuts much more easily than dry rubber and this suggests the need of extra careful driving of the motor truck during the spring months when the roads are in bad condition. Sharp stones, car tracks or stray bits of metal will cause cuts in wet rubber, yet they might not damage the same tire if it were dry. A careful driver will avoid car tracks at all times, but will be particularly careful in wet weather as a sharp frog end may gash a tire very badly, especially if the rails are wet.

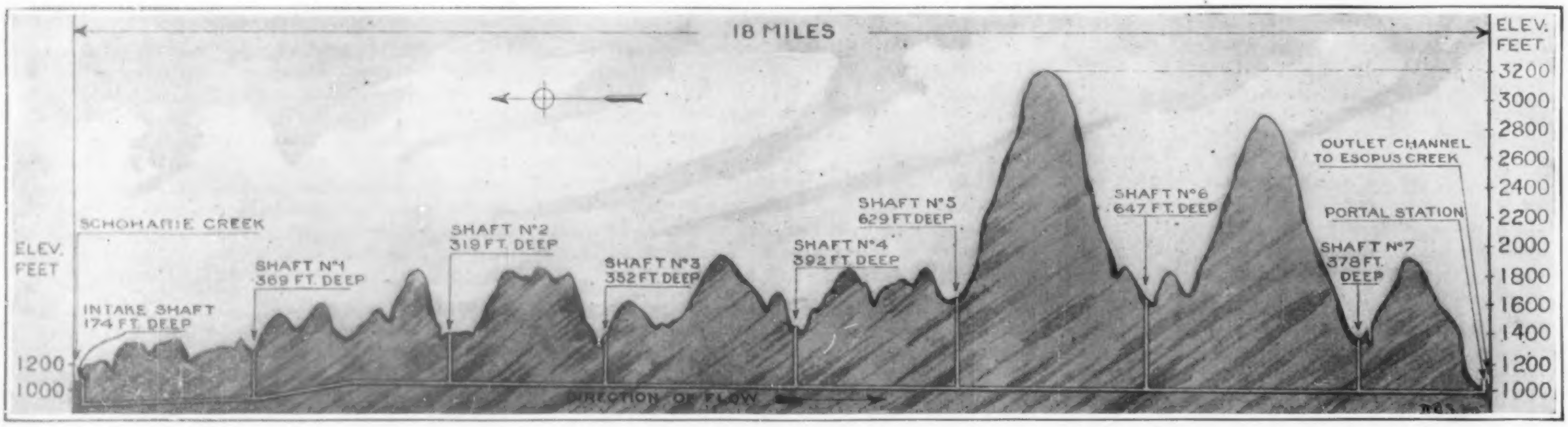
Automobiles in the Philippines.—American motor vehicles continue to predominate in the Philippine market, according to a compilation recently made by the United States Bureau of Foreign and Domestic Commerce. The total number of trucks registered in 1918 was 567, with a tonnage capacity of 1,052 and a passenger capacity of 6,345. Due to the lack of railroads and the need to transport agricultural products, motor trucks are beginning to play an important part in the country's commerce but their general use is being largely restricted by the lack of good highways.

Notes on Lubrication.—Automobile drivers often find oil leaking into the brake from an excessive supply in the differential housing. The excess oil is forced through the axle tubes and runs out along the shafts in some designs while in others the interiors of the shaft housings are fitted with tubes, which catch the oil before it gets to the brakes. In any event, keeping the oil level in the housing at the proper height will prevent most of the leakage. In filling the gearset put in the lubricant to a depth of about half the height of the gearbox. That is, have it come about even with the center of the main shaft. This will submerge the countershaft and bring the face of the main shaft gears into the lubricant.

A New Vaporizer.—Strong claims are made for an electric vaporizer said to be the invention of Clyde B. White of Rome, New York, which is to be produced and marketed by a well-known Buffalo concern. Its promoters believe it may revolutionize the use of fuel and ignition systems now required for internal combustion engines. With this, spark plugs and carburetors are claimed to be unnecessary. Statement is made that during a test with a six-cylinder engined car 63 miles were traversed with a gallon of gasoline, and with a four-cylinder car 90 miles. The inventor is a mechanic employed by a local brass company and has spent some time in developing the device for which he has patent rights. The vaporizer is not yet ready for marketing.

Another Substitute for Air-Filled Tires.—A retired Norwegian army officer is said to have perfected a new spring wheel that he claims will serve as an efficient substitute for pneumatic tires used on motor vehicles. It involves the use of steel springs tangentially applied to the wheels, with an outer rim of solid rubber, steel, wood or other material. The inventor claims that spring wheels manufactured to his designs may be used on motor trucks and street cars as well as on lighter vehicles. The shortage of rubber in Germany and neighboring neutral countries made it necessary to develop spring wheels as a temporary expedient during the past war, but there is no record of these designs being successful enough to displace pneumatic tires when these were available.

Tractor for Canal Traffic.—Reports from Belgium indicate that a new hydraulic transmission tractor for towing canal boats has been put into successful operation at Liege. This apparatus insures much more rapid transit, and is also less expensive than towing by steam, horse or man power. Boats of 350 to 400 tons which now require 10 to 12 days to make the 153 kilometers (95 miles) from Liege to Antwerp, arrive at their destination in five or six under the new system. It is also claimed that the tractor has the advantage of not straining the tow line in getting under way because of the gradual application of power and the danger of collisions with other boats and with quays and embankments is diminished. There is also a saving of time in passing through the locks. No details are yet available, but it is probable that an internal combustion engine is used as a prime mover.



Longitudinal section, contracted, showing the way in which the tunnel will be driven through the solid rock of the Shandaken mountains of the Catskill range

Piercing the Catskills for Water

Some Constructional Details of the 18-Mile Tunnel Under the Shandaken Mountains

By Robert G. Skerrett

THAT New York City's cup may be full—of water—engineers are engaged upon the construction of a vast rock-hewn aqueduct which will pierce, when finished, the foundation of a part of the Catskill range for a distance of substantially 18 miles. By means of this conduit through deep-buried shale and sandstone, the flow of the Schoharie watershed will be linked with that of Esopus Creek, immediately tributary to the great Ashokan reservoir.

To effect this union, the tunnel now in process of forming will be cut through the backbone of the mountains at depths ranging from 255 feet to 647 feet below surface level. At one point, however, the tube will be bored 2,200 feet beneath an overtopping peak; and from end to end the gigantic watermain will have an internal height of 11½ feet and a width of 10 feet 3 inches. This subterranean artery will make it possible, in the season of plenty, to transmit daily from the impounding area of the Schoharie reservoir quite 600,000,000 gallons of water to the less abundantly fed Ashokan reservoir. This means that the city of Greater New York shall not want for this vital fluid for many years to come, thanks to the provision of the men who first conceived the whole scheme of the Catskill water supply system back in 1900.

The SCIENTIFIC AMERICAN has already described the Gilboa dam by which the Schoharie Valley will be transformed into a basin capable of holding fully 20,000,000,000 gallons of potable water. This dam is now in the preliminary stages of construction across Schoharie Creek at Gilboa. The tunnel will serve to connect this storage with the completer portion of the Metropolitan water supply system by the shortest practicable route. About six years back, the project was opposed by the State Engineer on the score that it might lessen the needed water feeding into the State Barge Canal via the Mohawk River, and that official then urged that the area contiguous to Catskill Creek be developed instead. To utilize effectively the Catskill reservation would have called for the creation of three impounding reservoirs; and in order to lead this flood into the main basin at Ashokan it would have necessitated the construction of an aqueduct nearly 30 miles long. Apart from the heavy outlays this would entail, the plan could not be executed with comparable promptness. Therefore, the authorities wisely settled upon the present Schoharie-Esopus tunnel. On the 9th of November, 1917, the contract for this work was awarded, the price for the total undertaking being then fixed at $12,138,738. Up to the end of 1919 the disbursements amounted to 11.1 per cent of this sum.

The tunnel intake is located about 3½ miles north of the village of Prattsville, New York, whence the line of the aqueduct extends in a generally southeasterly direction, coming out just south of Allaben, where it meets Esopus Creek. As shown by one of the illustrations, the conduit is of horseshoe section, and will be concrete lined from end to end. The scheme calls for a uniform slope of 4.4 feet per mile except for the northerly 3½-mile stretch, which is depressed, so that this part of the tunnel will be fully charged and under hydrostatic pressure when in operation. Between the intake and the discharge stations there are seven intermediate shafts, representing an aggregate depth of 3,238 linear feet; and it is by means of these shafts that headings are being advanced north and south in blasting the 18-mile hole within which the concrete shell of the tube will be molded.

The intake shaft and the seven other shafts of greater vertical penetration all have an internal diameter of 14 feet, and each of these is equipped with the needful apparatus for bringing the spoils to the surface, lowering and raising the workmen, and for carrying below the electric cables, compressed air, and the blower connections for insuring satisfactory ventilation. The minimum distance between shafts is 1.3 miles, and the maximum is 2.7 miles. Telephone communication is provided for between the tunnel and the surface via the shafts, and all power machinery and tools underground are operated either by electricity or compressed air. Subterranean illumination is furnished by electrical lights.

Inasmuch as the excavation of rock will be done by blasting, it is essential that the circulation of air at the tunnel headings shall be free enough to deal quickly with fumes and smoke. Besides the gases given off from the dynamite charges, the dust generated by blasting and the dust produced by the drills must be removed promptly both for the health of the operatives and to facilitate clear vision for the surveyors. To supplement the ventilating system, the contractor is required to install reinforcing fans, or boosters, at intervals of not more than 2,000 feet apart. Needless to remark, pumping equipment is called for of sufficient capacity to handle all water entering the tunnel during construction and before the portal station is reached, after which the incoming seepage may be allowed to seek a natural outlet downward to Esopus Creek.

As experience has dictated during other tunneling activities of the Board of Water Supply of the City of New York, precautions are being taken for the stowage of explosives under ground; for the localizing of the effects of blasting; and to minimize the possible

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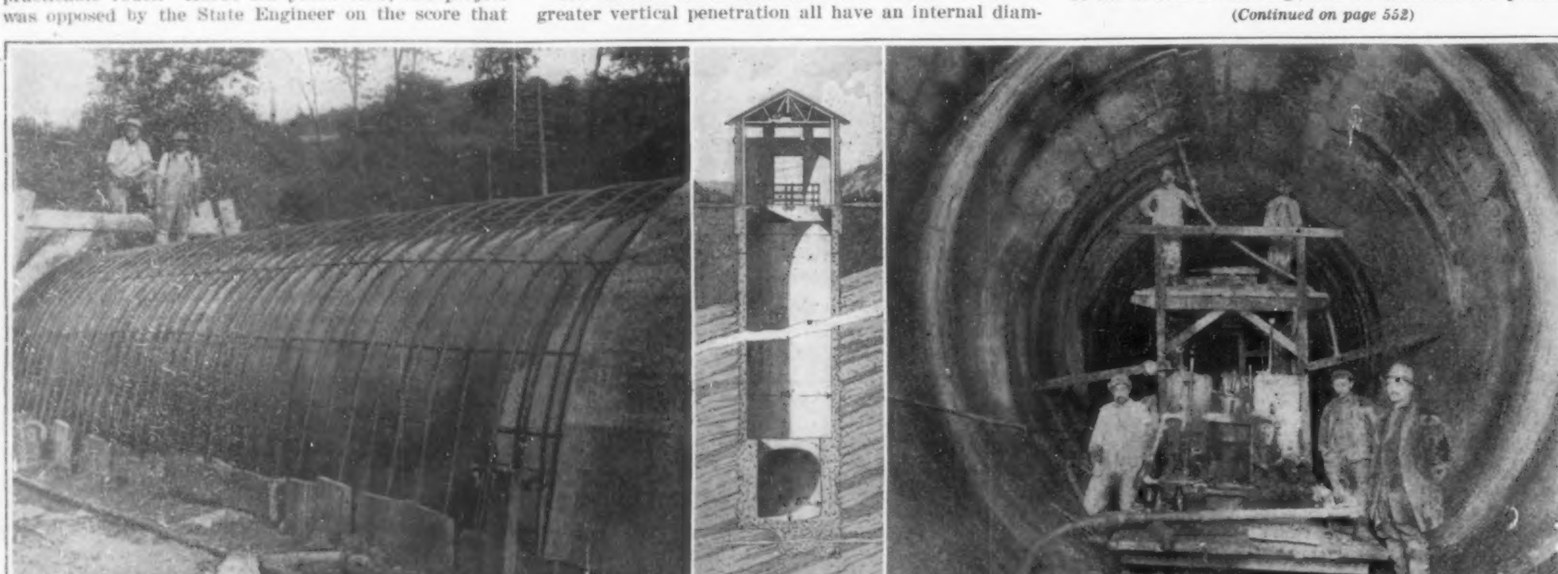

Left: The manner in which the cut-and-cover southern end of the viaduct will be fashioned of reinforced concrete. *Center:* Cross-section of one of the vertical working shafts surmounting the horse-shoe-shaped tunnel. *Right:* Showing how the grouting machine serves to fill up the space between the rock excavation and the outside of the tunnel's concrete shell

Making a River Pump Its Water Uphill

By Ralph Howard

THE plan of making a river or a tidal current operate some form of mechanism for producing useful power has always seemed to be attractive to the inventor. Many such motors have been planned, and several of them, from time to time, have been tried out. The simplest form of current motor is, of course, the ancient undershot wheel, whose power output is limited by the fact that only a few of its floats are immersed at the same time. The power developed by this type in a river current of average velocity or in a tideway is so small that inventors turned to the plan of providing a long, endless belt of successive floats or paddles, in which the great area subjected to the water pressure would compensate for the slow speed of the current.

The motor which is herewith illustrated is of a type, in which, instead of presenting the face of the floats squarely to the current, they are arranged obliquely so that the resultant movement is not with the stream, but across it. Many of us will remember the early form of river ferry in which motion was accomplished by means of a cable, a trolley wheel running thereon, and a cable passing from one end of the ferry boat through a sheave at the trolley and back to the opposite end of the ferry boat. This second cable passes through a sheave at each end of the ferry boat and is brought to a drum around which several turns are taken. By this arrangement the boat can be placed at an angle to the flow of the river and so be moved across the stream in either direction. The travel of the boat across the current is due to the pressure of the water against its inclined upstream face. This pressure is resolved into two components, one representing the pressure normal to the side of the boat, and the other component being the lateral pressure which propels the ferry from bank to bank.

Now this thrust of the water upon a float presented at an angle to its flow is utilized by F. L. Gilman, of Los Angeles, in the construction of a pump which may be used for raising water from the river which drives the mechanism to any desired elevation for irrigating farm lands or for other useful purposes. Our illustrations show a six-horse-power plant, which has been in operation in the Los Angeles River for several weeks. We are informed that it cost between $500 and $600 and that it delivers eighty-six gallons of water per minute through a three-inch pipe to an elevation of

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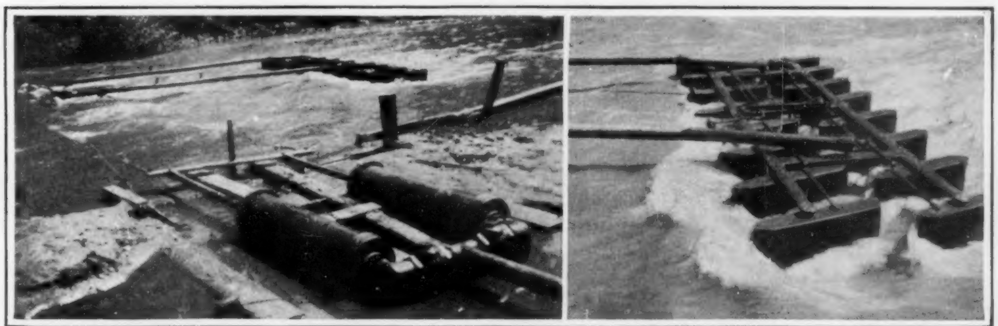


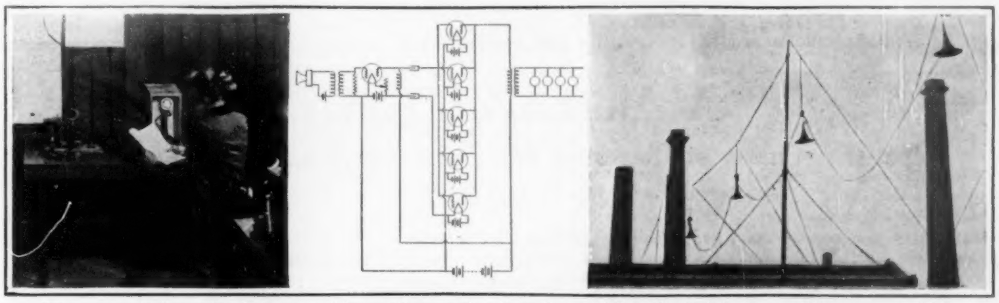
The pumping units on shore and the sixteen planes or paddles arranged in two rows and placed in the stream

Talking to Thousands by Electrifying and Amplifying the Speaker's Voice

IT was during New York's Victory Loan drive, about a year ago, that the loud-speaking telephone installation was employed for the first time in addressing thousands of people. This system then consisted of hundreds of loud-speaking units arranged on overhead cables, and a vast collection of storage batteries, amplifiers and controls, all leading to the microphone in front of the speaker. Since that time the loud-speaking telephone and amplifier system has found its way into industrial life, notably in Great Britain.

The accompanying illustrations show the installation at Woolwich Arsenal, London, where orders are given to thousands of workers by means of loud-speaking units distributed throughout the works. The components of this system are shown in the wiring diagram, which is immediately clear to those of us familiar with electrical engineering in general and radio telegraphy in particular. It will be noted that the microphone, into which the speaker throws his voice, is connected with a telephone induction coil and a battery; the secondary of the induction coil is connected with a vacuum tube, the output of which is delivered to five amplifier tubes, which, in turn, deliver their greatly magnified output to the loud-speaking units through the agency of a transformer.

The loud-speaking units, it will be noted, are provided with a large horn and suspended from cables. By installing these units outdoors and indoors, any part of the plant can be reached.—By *George Gaulois.*



The young lady at the left can address thousands of workers of the Woolwich Arsenal by means of the connections shown in the diagram, and the loud-speaking units shown at the right

To Offset the High Cost of Ice

By W. Lambert

WHEN President Roosevelt installed a refrigerating plant in the executive offices of the White House so that the employes might carry on their work in the torrid days of summer with comparative comfort, most people approved of the act while caustic opponents volunteered opinions about rising taxes. The refrigerating system installed was elaborate and efficient but it required pumps and motive power and the services of an engineer to run it.

Since that time a great deal of study has been given to the subject of refrigeration; and a system has been perfected which not only has no moving parts such as pumps and motors, but which produces refrigeration or makes ice at a cost so low as to bring it within the means of the average man. In view of the rising costs of both natural and artificial ice, the new system is of considerable interest at this time.

The new system uses gas for fuel. With artificial gas of 650 B.t.u. selling for $1.00 per 1,000 cu. ft. it has been found by tests and substantiated by actual experience, that it costs about 80 cents to make a ton of ice or to produce an equivalent amount of refrigeration. In most places this is less than the cost of either artificial or natural ice.

While it is improbable that homes will ever be cooled in summer in the same general method that they are heated in winter, with this method using gas for fuel, it would be possible to do so. Its most general application is in homes, in apartments, in hotels and restaurants to keep ice boxes cold; and in meat shops, hospitals, florist's shops, and the thousand and one other places where it is now necessary either to use ice or employ an engineer to run a refrigerating plant. For family ice boxes and for apartments it is the usual plan to place the new system in the basement which distributes cold brine through pipes to refrigerators or ice boxes on the floors above. The tendency is generally to avoid making ice when the same result can be obtained by simple refrigeration.

The new system has no moving parts and no intricate mechanical devices. Furthermore no skilled labor is required to operate it. For these reasons the application of the system to cooling problems is almost limitless.

The system operates with the simple application of heat instead of mechanical energy. The system is divided into two methods of operation: the intermittent,

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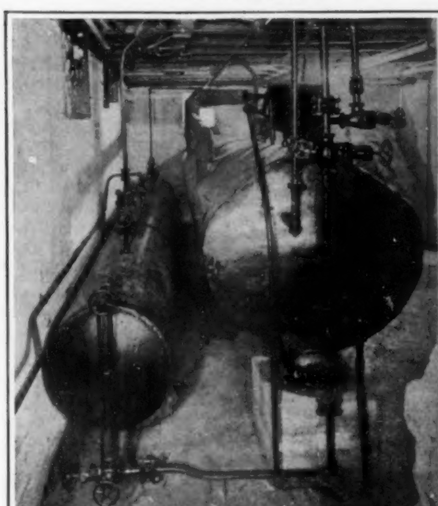
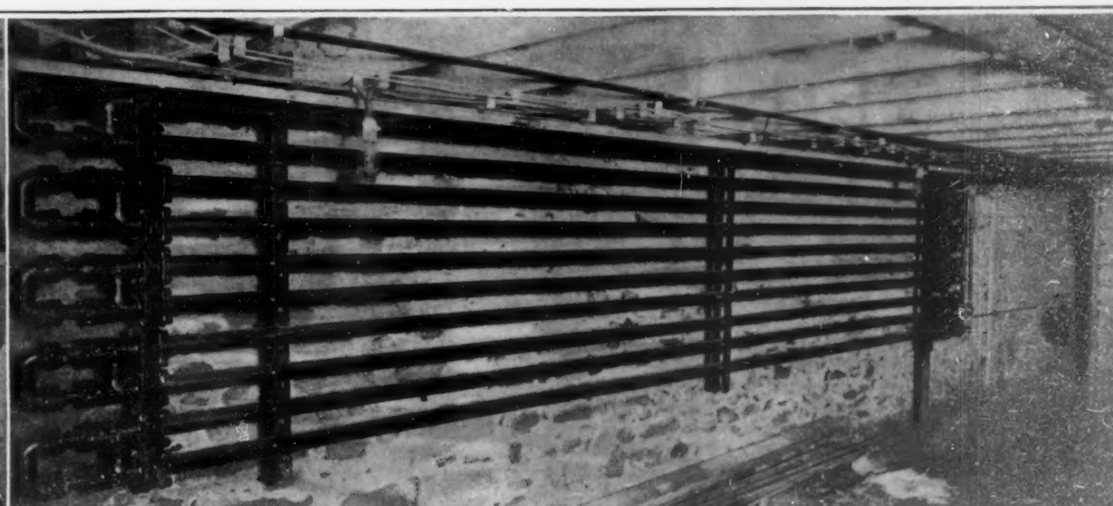
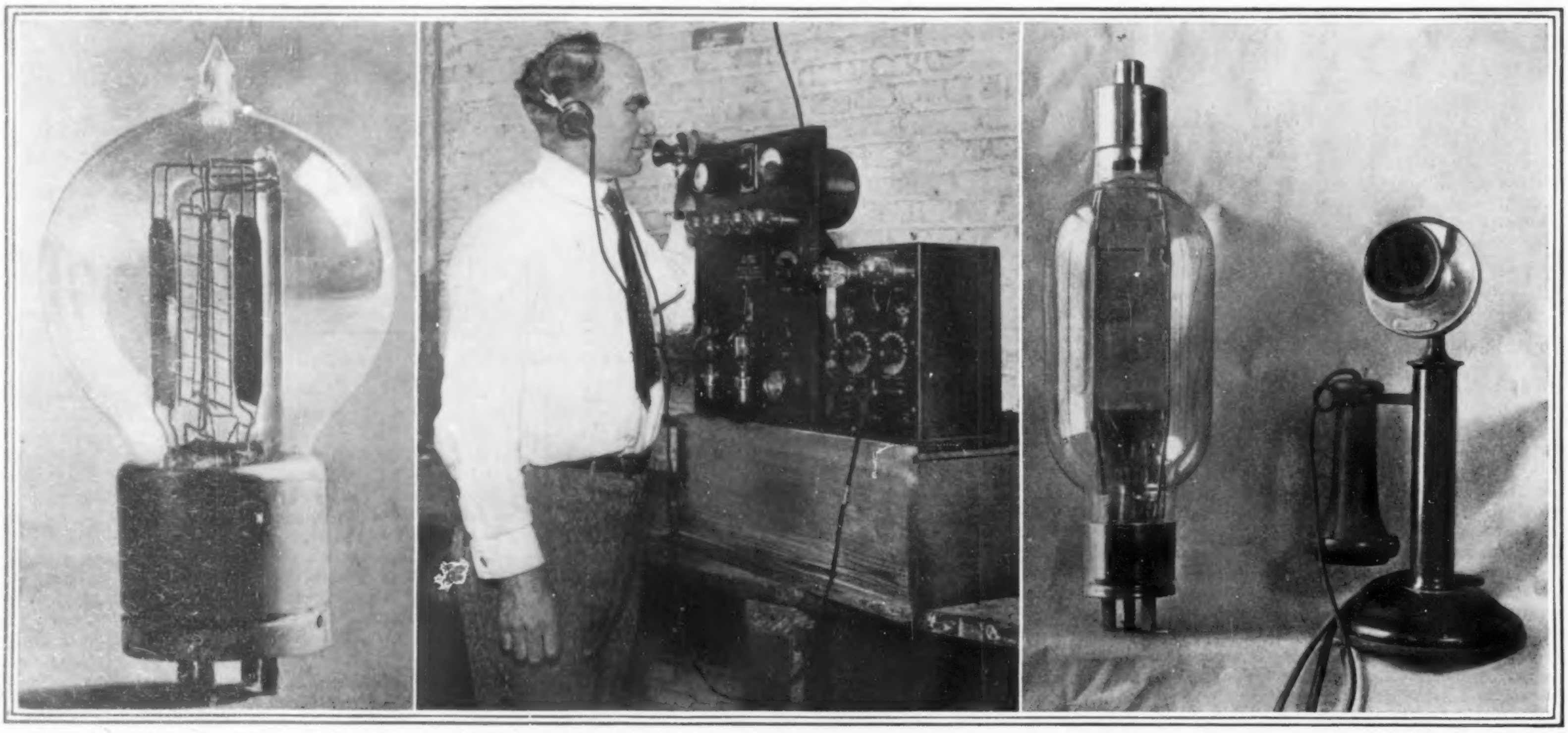


Gas-heated generator at right: ammonia receiver at left. The installation is in the basement



Condenser to condense the ammonia gases made by the generator. The receiver is in the doorway at the right. With two generators the refrigeration system becomes continuous



Left: A typical vacuum tube of today, showing the plates, grids, and filament. *Center:* Dr. Lee De Forest and his latest wireless telephone set which operates from the ordinary lamp socket. *Right:* An oscillating audion or giant transmitting bulb compared with the standard desk telephone. This bulb is of one-kilowatt rating.

A Merlin of Today

What the Audion of De Forest Has Done and What It May Yet Do

By C. H. Claudy

WE call him famous whose name is known from end to end of the earth, and of whom we can say, "He did thus and so; he was responsible for such and such; he is doing this and that." But of all those who have won fame, only the man is considered great whose name is indissolubly linked with some one achievement of such magnitude and such importance that the world, once accustomed to it, cannot exist without it. Newton—gravitation; Stephenson—steam engine; Roentgen—X-rays; Galileo—telescope; Marconi—wireless; Wright—airplane; Napoleon—leadership; Roosevelt—Americanism; these are the sort of men whose names stand for some one definite thing achieved. There are dozens more—but none ring more truly in the ears of those who know the modern field of electricity than that of De Forest, with the accompanying thought of the audion.—THE EDITOR.

WELL may we classify **De Forest** among the great, and include the story of the audion in the romance of invention. For the audion is black magic, and its creator a Merlin of today—a wonder worker who takes a glass tube and some bits of wire, and with them gives to science a new tool, to telephony a new range, to wireless its commercial possibility, to physics a research apparatus which has divided the oldest of the sciences into pre-audion and post-audion eras. Here we have a tiny collection of the simplest of materials which are indispensable in the laboratory, in the field of war, in electrical science in general and in the long distance transmission of signals in particular.

In sketching a man who has done something, the natural starting point is "Who's Who" and a rapid copying of the date of his birth, place of education, commercial connections, scientific distinctions—in other words, a boiled down epitome of his life. But there is nothing apparently "natural" about an audion so this sketch is not going to be written in the "natural" way. Few know or care whether Newton was a college graduate or whether he married, whether Marconi be a church member or an atheist, if Edison be a Republican or Democrat. None, one fancies, seeing an audion at work and realizing in even a faint measure what the small glass miracle may be, will care much what its parent was before he fathered it. De Forest made it, out of his brain, for the benefit of a waiting world. That is the most we need to know.

And he doesn't look the part. He ought to have a leonine head, surmounted with white hair, and a stern, grave face as befitted a head concerned with such far-reaching demonstrations of the fact that there is a lot left to learn. Instead of that Dr. De Forest looks like a first rate athlete engaged in some particularly happy occupation. He smiles much, and pleasantly. A pair of broad shoulders foretells quick, active movement before he stirs. Rather keen eyes are generally filled with laughter, as if the world were a good place to live in, and experiment in, and in which to make audions. He takes his visitor through his factory up beyond High Bridge, New York, with the simple pleasure of the craftsman and none of the pedantry of the very erudite. He talks audions and electrical science in terms of one syllable to the uninitiated as unaffectedly as he will speak in terms of *pi* and x-square to the *nth* power to the learned. Perhaps it is because the audion is such a simple thing to look at, even to make, that its maker has so simple and direct a human contact.

About now, if not a little sooner, the exasperated reader is getting ready to slay the present scribe for not getting down to the point and explaining what an audion may be, anyway. It has been described often enough—even in these columns, and recently. But there has not been enough said of it—even its users do not know its possibilities.

An audion, so named from the fact that the use of "ions" makes possible the "audibility" of weak impulses, is nothing but a small vacuum tube in which is an electric light filament, which may be heated by an electric current, a small (usually nickel) "grid" or arrangement of wires in the form of a "gridiron" and a small plate of metal (again usually nickel). Nothing could be simpler, yet this most uncomplicated piece of apparatus is to weak electric impulses, and finally to the ear, what the microscope—aye, the ultramicroscope—is to the eye, of which comparison more in a moment.

Perhaps the first and by no means the least important commercial application of the audion was to telephony in long distance work. Patented by De Forest in 1907, it was not perfected until 1912, when it was brought to the attention of the telephone and telegraph company, which one year later purchased an exclusive license of the patents for wire telephone work. In 1915 we 'phoned from San Francisco to New York with the same ease and clarity of hearing that we 'phone across the street.

The audion made it possible. The way the audion made it possible, if we can say that words can really convey a "way," is this. The incoming current, which is to be amplified, made larger, is connected to the "grid." The outgoing line is connected to both plate and filament. When the filament is heated, a tenuous stream of "ions" hurtles from filament to plate at an inconceivable speed, measured in miles per second. In this passage they must pass through the "grid." But the number or amount of ions which make the passage in safety depends on the amount of current flowing through the "grid." Ask not how or why; with the secrets of gravity, the nature of electricity and the hidden reason for magnetism, this is an unanswerable question. The fact remains. The more potential on the "grid," the less ions reach the plate. This change is always exactly proportional, but it is a magnified proportion; the changes in current so produced are from six to ten times the intensity of the changes which caused them. Hence the name "amplifier" as supplementary to "audion."

It is difficult to convey an adequate idea of the daintiness and accuracy of this new method of increasing the strength of telephone currents. To compare a load of coal and a soap bubble has been one expression used in comparison of an audion and a microphone. But another comparison is more directly to the point. Cable circuits a thousand miles in length have been operated with thirty audion amplifiers connected in tandem, producing excellent speech at the end of the line. Now the attenuation of current in a thousand mile cable is something almost unbelievable. If all the energy received from the sun by the earth could be concentrated as electricity at one end of such a cable (not destroying it in the process) and used for operating a telephone, there would not come out at the other end enough current to produce audible speech. But with the thirty amplifiers, ordinary telephone currents produce ordinary speech at the end of such a line. Such an amplification is expressed by

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Hoboes of Industry

How the Picturesque Wanderer of Yesterday Has Been Replaced by the Present Floating Labor

By H. A. Mount

JUST when we had finally succeeded in nicely card-indexing and cataloging the hobo, he suddenly disappeared from his old haunts. But, like a bad penny, he has turned up again—dressed in a new suit of clothes, it is true, and traveling on the "cushions" instead of the "bumpers," but still a hobo and unchanged in many of his old-time proclivities. Labor investigators have suddenly come to the realization that the hobo, in his new rôle, is contributing more than his just share to the high cost of everything and is decidedly a factor in our modern industrial situation.

One investigator for the United States Department of Labor spent several years before the war in a study of the casual laborer—the hobo—and just when his valuable conclusions were ready for publication the war came on and overnight the data he had so laboriously collected was obsolete. It was never published.

Today data on the subject of floating labor is almost non-existent. The whole problem, in its new aspect, is so new and is changing so rapidly that even men who are nationally recognized as authorities on the subject admit ignorance of any statistics. Those statistics which do exist are compilations of guesses at the facts and are of little real value.

A cross-section of opinion as to what has really taken place, however, runs about like this:

"Industry has absorbed the hobo. He has been tempted into the shops by high wages and scarcity of men. But he is still a drifter and is constantly changing jobs or moving from town to town. He is a shirker on the job and gives just as little as he can in return for his wages."

This modern industrial hobo is adding to high prices in three distinct ways. First, he is adding to the "labor turnover" in our factories. It has come to be universally recognized that for every man replaced in a factory, there is a definite loss. This loss, of course, varies with conditions and has been estimated variously from $20 to $250 for each man replaced.

Secondly, the hobo is adding to costs because he does not give a day's labor for a day's pay. Similarly might be classified many other resultant losses, such as wasted time of executives, wasted material, increase in the number of accidents, and a general lowering of the organization spirit.

Thirdly, those seasonal employers of labor, such as our western farmers, who once depended largely on hobo labor, now find themselves confronted with a serious labor problem because of the withdrawal of the hobo to other fields. Their problem is rapidly being translated into increased costs.

Even before the war the labor turnover in our factories was of startling proportions, representing in a year perhaps half of the total number of employees in the country. Says Mr. Don D. Lescohier, an eminent authority, in a recently published book: "Fully half of our labor passes through our industries, rather than into them."

Dr. Sumner Slichter, a recognized authority, made an investigation just before the war which disclosed that 105 of our big plants, employing 226,038 men, in a single year took on new employes numbering 225,942—almost 100 per cent turnover!

Of course a great part of this turnover can be called "normal," due to such causes as a man quitting to accept a better position, because of ill health or retiring, changing occupation, etc. Much of it is undoubtedly due to a characteristic American restlessness. Says Mr. Lescohier:

"Mechanics, laborers, clerks, salesmen—all sorts of workers—are continually influenced by the characteristic American hope that there is a big opportunity *somewhere else* for them. The very ambition which is a spur to progress in America is also a force which causes restlessness in the job and leads to failure in thousands of cases."

Let a man lose faith in himself under such a condition of restlessness, let him yield to the roving impulse until it has become a wanderlust, and we have a hobo. Many of our hoboes come from this class of dissatisfied workers. But not all. Observers agree that one of the chief producers of the oldtime hobo was drink. It is also agreed that under prohibition there should be a reduction in numbers, but not extinction.

It is doubtful whether there has been any decrease in numbers because of other aggravating conditions. High wages paid to boys have encouraged thousands of them to "hit the road" and see the world. The man who has any desire to rove finds it absurdly easy to do so because by applying at some local employment agency he could always find some firm willing to pay his expenses to the next town. Many men take advantage of this offer of free transportation without intending to work upon arrival. It is a common experience of labor recruiters to have a gang of men dwindle to a handful between the railroad station and the factory. And of those who do reach the point of working, only a few stay more than a day or two, or perhaps a week. Having no ambition beyond the immediate possession of a few dollars, or perhaps a suit of clothes, the man does just as little work as possible on the job.

As an extreme instance of the evils resulting from this practice, there is the case of a Connecticut manufacturer who, during the war, built a very delicate piece of ordnance, costing about $10,000 to manufacture. The nature of the piece was such that if even a slight mistake was made, the whole thing had to be scrapped. Highly skilled mechanics were required and even then a man spoiled one or two pieces before he learned to make them. The firm estimated that it cost them $10,000 to train a man for the work. And yet several instances were found where other firms attempted to attract these workmen from the job with offers of higher wages in other lines of war work.

Closely allied to the hobo workman is a certain type of foreign workman who suddenly finds his weekly pay envelope doubled. He is used to living in a hut upon a very low scale of existence and sees in increased wages no chance to better his condition. It only means to him a chance to work less and so he only puts in half the time he formerly did, although he may remain on the same job. By the same token he slackens his pace while he is at work, for if he is "fired" he can easily get work elsewhere.

Among these new "knights of the road," just as among the old-time Weary Willies, there are readily discernible two classes of men. The first is composed of young fellows who want to "see the world" and who do not care how they see it. Usually bad or indifferent home influences can be blamed here. The other class is composed of men of middle age or past who regard themselves as failures. They have worked—worked hard most of them—and have been ambitious. But they have failed. Then usually something has happened to sever home ties. Maybe the wife has died or his small business failed; perhaps he has disgraced himself in the eyes of his friends and neighbors and doesn't want to be seen among them. At any rate he becomes a drifter.

But we must not try to classify hoboes too strictly. By the very "nature of the animal" he defies classification. We must not think of him as a criminal, for the real hobo, within his own social circle, adheres to a rather rigid code of ethics. Neither must we underrate his intelligence.

"I have never seen a gang of hoboes in my life," says Mr. Willard Beahan, a veteran railroad engineer of Cleveland, "but that there was one or more among them smarter than I. And if you need a man of special ability—whether it be a lawyer or a skilled mechanic—you can nearly always find him in such a gang."

Mr. Beahan has been dealing with hoboes for forty years, "hiring them and firing them, sleeping and eating with them, working with them and playing with them." He has had thousands of hoboes under him and has completed several railroad construction jobs with none other than hobo labor. One of these was the laying of a railroad line through hostile Indian territory in Oklahoma in pioneer days and another was the construction of the great Cascade Tunnel. His has been the unique experience of never having a gang of men go on a strike.

"You can't assume an attitude of superiority among a gang of hoboes and expect them to stay with you. You have got to be one of them—wear the same kind of clothes and eat the same food. You can't overcharge them for their food or give them hard beds without seeing an immediate reduction in the size of your gang. But it is my experience that if you treat them right, at the end of ninety days you can count on sixty per cent of these fellows sticking with you through thick and thin and they'll work their finger-nails off in an emergency."

Another significant point is that Mr. Beahan picked from these hoboes his foremen and often his whole staff of assistants. One of the most troublesome traits of the hobo Mr. Beahan found to be the almost universal practice of setting a "stake" of $10 or $15 as the maximum amount of wealth the hobo could possess at one time. When he earned this amount he felt free to "cut loose" and drift until his "stake" was exhausted.

But is not all this rather antiquated information? Has the modern industrial hobo inherited these proclivities of his predecessor?

Apparently he has. His "stake" is higher now and his mode of travel has changed, but he is a drifter for very much the same reasons and he responds to similar treatment in a very much similar way. One great factory reduced its labor turnover from over three hundred per cent a year to about fifty per cent by changing its method of handling men. Under the new plan every incentive possible is given for personal advancement. Foremen and other executives are picked from the working force so that the workman can actually see the reward for merit. Wages are high, but are based largely on individual productiveness. The workman is encouraged to study and to become an expert in some line and above all he is encouraged to establish a home. He is given financial assistance in this direction. In other words, he is furnished with the things, the lack of which has made him a drifter. He is made to feel that effort on his part will bring a proportional reward and he is encouraged to "take root." The monetary gain to the manufacturer in this instance amounts to thousands of dollars annually.

The entry of the hobo into industry has forced us to the conclusion that he really had an economic value in the normal scheme of things in this country, in spite of his aversion for work. Our demand for seasonal labor is enormous, and we have heretofore depended largely on the itinerant worker to fill it.

Now that he is gone, who will harvest our great western grain fields? Who will pick our eastern fruit crop? Who will man our lumber camps? The old-time hobo did all these things and a thousand and one others. Between seasons he worked with railroad gangs, gathered oysters in Chesapeake Bay or salmon on the Columbia River.

One eminent investigator estimated that in 1917 there were five million casual workers—hoboes—in the United States, and that this army was being swelled by recruits faster, in proportion, than our population was increasing.

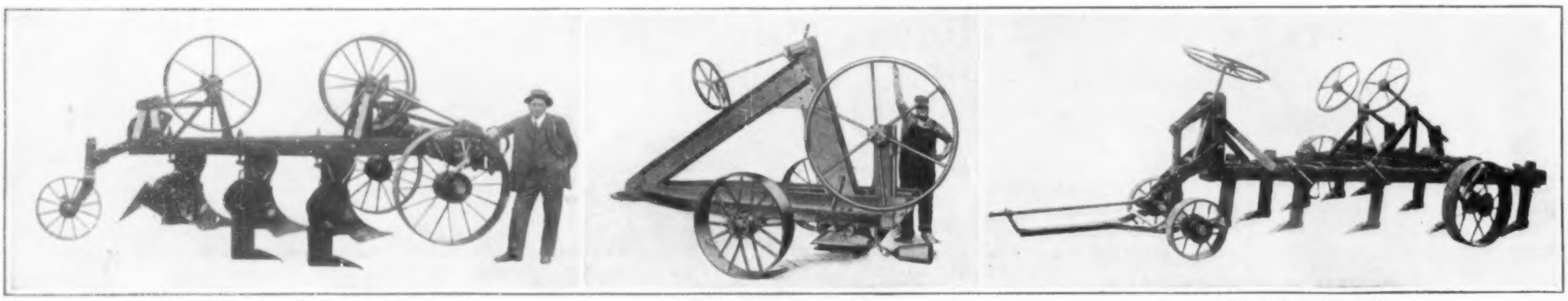
These men are gone now. There is ample evidence of it. Cheap lodging houses which used to swarm with them have been deserted in the past year. Cities which have depended on hoboes to clear their streets of snow in the winter found difficulty in getting a few men at any price last winter. The great municipal lodging house on the East Side in New York, which used to shelter thousands of these drifters every night, sheltered only a few dozen last winter, and the Commissioner of Charities of New York has just proposed selling the institution because it is no longer of use.

Heroic measures had to be taken to gather in our western harvests last year and the farmers face even a worse situation this year. A gathering of the employment men upon whom the burden of finding harvesters will fall has just been held in Kansas City. Everyone urged the seriousness of the situation but the only measure which promised relief was a decision to appeal to the college student to spend his summer vacation in the harvest fields.

Dr. H. Paul Douglass is making an investigation of this situation for the Interchurch World Movement and he has found that a similar condition exists wherever hobo labor was available in past years. It has been relieved in some sections, notably in our big orchard regions, by the employment of whole families of emigrants. Usually these families are large and every member, from the baby just learning to walk to the oldest, is counted as a wage earner. The whole family is moved from place to place as the seasons change.

The seriousness of the situation, however, lies not in the fact that higher wages must be paid, but in that it is doubtful if enough laborers of any description can be found to tide over the harvest season. But of these thousands of men who are constantly shifting about in industry, cannot enough of them be diverted to the wheat fields to meet the situation? Dr. Douglass thinks not.

Perhaps when we have studied the industrial hobo and are ready to tackle his case in earnest, he, too, will disappear and turn up again in his old rôle. Who can tell?



Combination subsoiler and plow — Gopher or drainage plow — Tractor chisel of moderate size

Three of the new tools with the aid of which farms are made from land that has always been found worthless

Making Bad Land Good

Land Reclamation the Next Step in the Fight to Feed the World

By H. A. Crafts

WHEN the savage began the history of agriculture by scratching the surface of the earth with a sharp stick in the effort to increase its yield of some food plant, he had first to seek a tract that would respond to his scratching. Ever since, the activities of the agriculturist have been confined by the same consideration. Mere absence of water he might overcome; if there were too much water he might even be able to do something in the way of a remedy. But land that he could not plow or that would not behave properly after plowing has always baffled the farmer. It would be too optimistic to say that the modern tractive machinery described in this story eliminates bad land entirely from the picture; but certain it is that this machinery extends the radius of farming operations over vast tracts from which crops have heretofore been excluded.—THE EDITOR.

THE time has arrived when the world must sit up and take notice; when the world must begin to think in world terms. It should recognize this cardinal truth, that there are no more continents to be discovered. If Christopher Columbus should reappear in carnal form today he would, like Othello, find his occupation gone.

Within the past 427 years the earth, socially, has been conquered. In the past hundred years we have been putting the finishing touches on the job. It has been a succession of exploration, discovery and exploitation. We have arrived, and are doing business. Our next problem is to regulate our affairs upon a world basis. Certain paramount issues must be considered:

First, the fundamental trade of husbandry. As it is today, the world-mind is obsessed with ideas of secondary importance—manufacture, transportation, trade, etc.

The greatest of all things mundane is the land. From the land are obtained all of those materials which go to make for human life, comfort and happiness. Agriculture is the foundation of society, all other occupations are largely devoted to the transforming and distributing of the products of the land.

The one great human fact evolved from the war was that there was a shortage of food when the crisis came. The world had not thought of the morrow. It had not laid up a food supply for a world-war emergency.

Nor today does it have a thought of tomorrow. It never occurs to the world that a certain store of food should all the time be kept on hand for use in case of widespread drouth, flood or pestilence. May not it be adopted as a public function, some time in the future, to store corn for use in dire emergency? Or, at least, if we seem disposed to defer such a wise arrangement, let us do the next best thing—husband those resources which we have in hand.

In previous articles I have pointed out two remedial methods that may be applied with profit to our handling of the soil—subsoiling, and refertilization by means of green manuring. We must take into account the fact that our ample food supply hitherto has come through the settlement and development of vast areas of virgin agricultural lands, and not by general skill, nor thoroughness in our farming methods. There may be found isolated cases of scientific, intensive farming in our country, but they are few and far between. The bulk of farming is conducted in a haphazard fashion that is slovenly and wasteful to an extreme degree.

Our farmers, as a class, have evinced a strong tendency towards individual exclusiveness, and aloofness. All these years they have been in a state of constant migration, principally westward. They have been seeking some Promised Land, which process only acted in a manner to accentuate their almost abnormal individualism. Many failed in the East, and went West to better their condition, landing in their new locations with small means, and bringing with them the crude agricultural methods of their fathers.

Hardpan brought to the surface with a subsoiler

So the farming mass has been flying off upon tangents, rather than getting together for mutual help and benefit. But the migratory days are about over. Our frontier has been pushed even to the shores of the Pacific, and from Mexico to the Canadian line. Our virgin areas have been pretty well settled up. The homesteader is becoming conspicuous by his absence. We have settled up the country, and now it becomes incumbent upon us, as thinking, rational beings, to look about us, for the setting of our agricultural house in order. Let us make a brief survey of our resources. What are our economic assets?

Within the arid regions, which virtually constitute the nation, west of the 100th meridian, if we except the Pacific Northwest, we shall find them in abundance. And we shall still find within this vast area large bodies of arable land, susceptible to the art of irrigation, with large quantities of water supply available for irrigation, and yet still unappropriated. Here may be seen a promising field for extending our agricultural system.

Again, there are still vast areas of arid land not susceptible to irrigation, from a simple lack of water supply, that may be made available by a system of scientific dry farming. And last, but not least, are our 102,800,000 acres of uncultivated swamp lands that may become available for agricultural purposes by means of reclamation.

Now when we come to the term "reclamation" we are struck, both by its applicability and its comprehensiveness; for when we reflect upon the point, it covers that function which we have been alluding to as re-fertilization. The reclamation of our exhausted soils that have been made so by defective cultural processes would really be the Ultima Thule of remedial measures. So let us include in our program of economic reform the reclamation of the three classes of lands—exhausted farm lands, arid lands, and swamp lands.

I have covered the first proposition in the category pretty thoroughly, so in the present article I shall confine myself to the discussion of arid lands and swamp lands. All farming not under the system of irrigation

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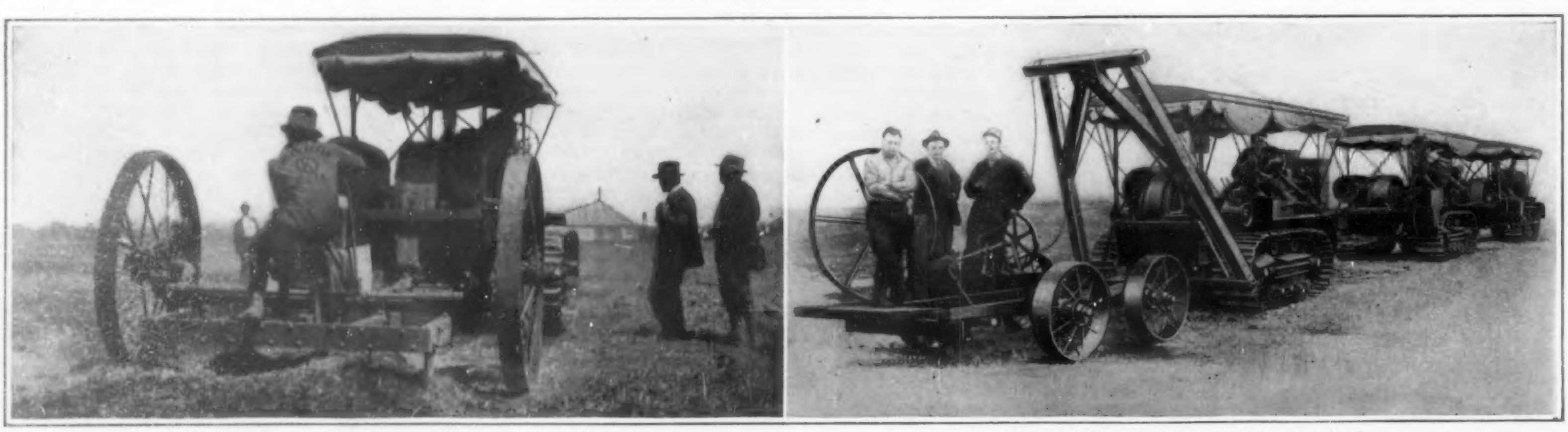
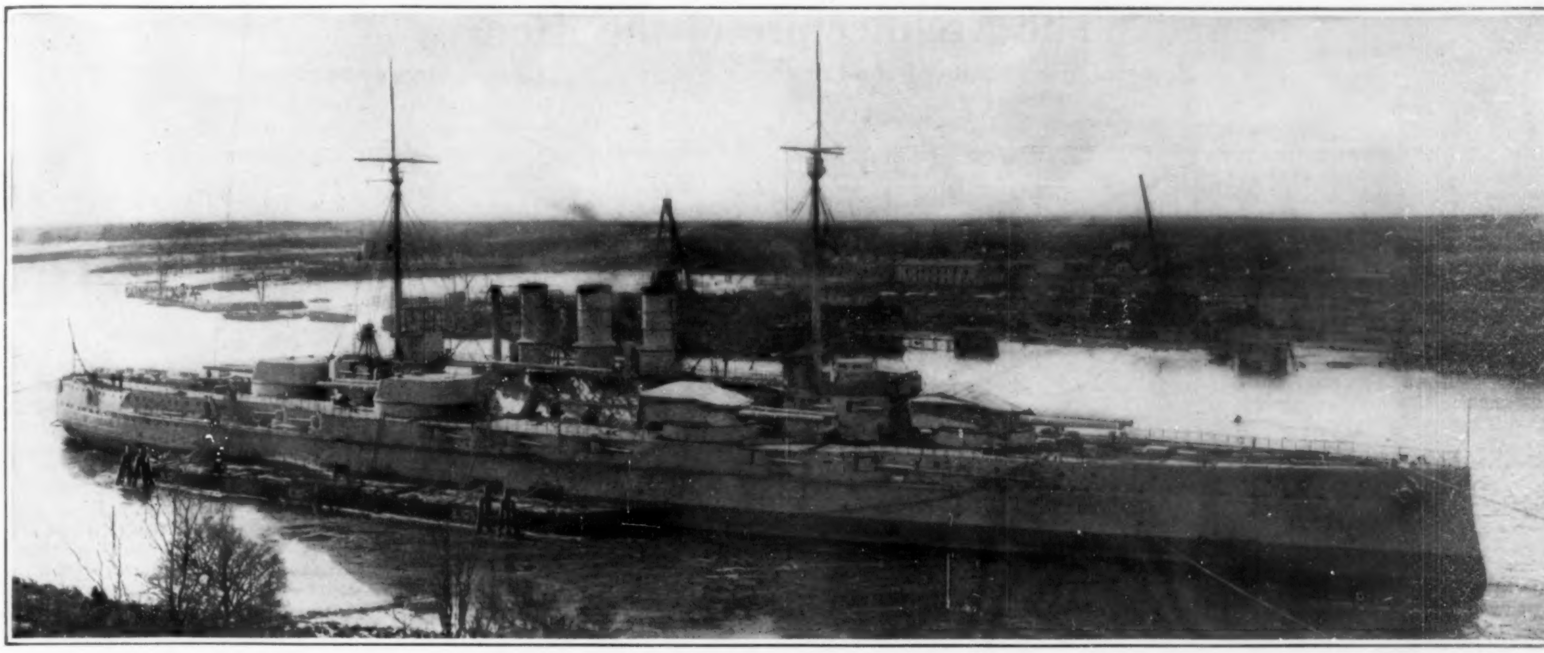


195 horse-power pulling drainage plow at depth of 4 feet — Big caterpillar at work with the tractor chisel

In the field with the latest devices for breaking up unsatisfactory land and making it arable



Length: 546 feet. *Beam:* 93¼ feet. *Draft:* normal, 27 feet. *Displacement:* full load, 24,500 tons. *Speed:* on trial 21 knots; today, doubtful. *Armament:* twelve 50-caliber 12-inch, fourteen 5.9-inch. *Armor:* belt 11¾-inch, barbettes and turrets 11-inch, deck 3.4-inch. *Torpedo tubes:* six of 19.7 inches.

The German dreadnought "Ostfriesland"

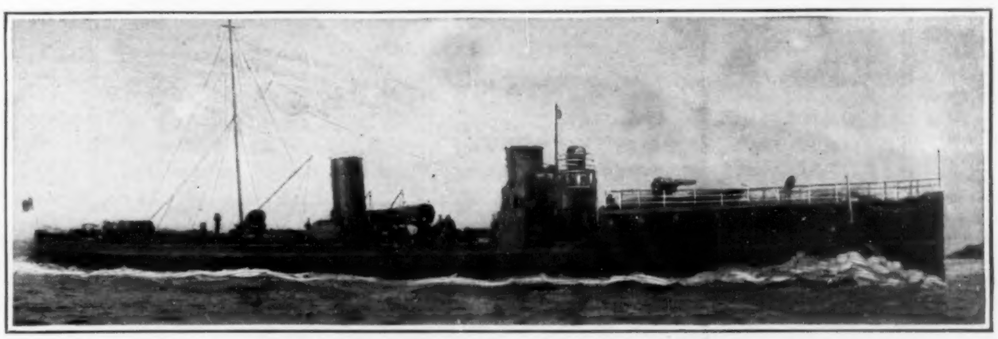
Our Share of the German Fleet

Five Ships That Fought at Jutland Are On Their Way to the United States

AS stated in our last issue, five German warships have been allotted to the United States, and are now to be brought by American crews to the United States.

The "Ostfriesland" is the largest, oldest and most important of these ships. She is one of the earlier Gerban dreadnoughts which formed the backbone of the German High Seas fleet throughout the war. Under the 1908 naval estimates, she was laid down at the Wilhelmshaven Navy Yard in October, 1908, was launched in September, 1909, and completed in August, 1911. She was built during the rapid stage of development of the dreadnought design, and added improvements have brought about an increase of displacement, and this, instead of making her top-heavy, steadied her and left her an excellent sea boat. The cramped internal arrangements of the "Ostfriesland" are characteristic of every German warship. The comfort and well-being of the crew were given but little thought by a German naval constructor. The steadiness of the "Ostfriesland" is said to account for the fact that up to the time of the war the vessels in this class were the best shooting ships in the German Navy. The main battery of the "Ostfriesland" consists of 12 12-inch 50-caliber rifled cannon. The guns fire a shell weighing 859.9 pounds at a velocity of 3,080 feet per second, giving an energy of 56,485 foot-tons. The anti-destroyer battery consists of 14 50-caliber 5.9-inch guns, mounted seven on each side of the ship. The belt is 11¾ inches thick, amidships and tapers to 5.9 inches at the bows and 3.9 inches at the stern. The barbettes are of 11 inches of hardened steel crowned with turrets of 11 inches. The conning tower, forward, is 13¾ inches thick and the signal tower aft 6 inches. The secondary battery is protected with armor 6.4 inches thick. A modern ship must have several armored decks and a large amount of internal armor to protect her from plunging shell fire and aircraft bombs.

The "Ostfriesland" has an armored deck reinforcing her belt and giving protection to her vitals, that is 3.4 inches thick. Her engines are in bad shape, but she may be able to cross the Atlantic under her own power.



Displacement: 800 tons. *Speed:* 35 knots. *Armament:* 3 4.1-inch guns. *Torpedo tubes:* six of 19.7 inches

A typical German destroyer

The "Ostfriesland" is one of a class of four dreadnoughts. The other ships of her class are the "Thüringen," "Heligoland" and the "Oldenburg." These ships, together with the four vessels of the "Westfalen" class, formed the famous German First Battle Squadron which took such an important part in the battle of Jutland, under the command of Rear Admiral Schmidt, flying his flag on the "Westfalen." This squadron went into action at about 4:45 in the afternoon of May 31st, 1916, but did not seriously engage the enemy until after nightfall. During the course of the action at dusk the "Ostfriesland" and "Thüringen" are credited by the Germans as having sunk the British armored cruiser "Black Prince" by their gun fire. At 5 o'clock the British commander, Admiral Jellicoe, was aware that the Germans must soon start to retreat. Being unable to pursue them for any distance because of his lack of proper searchlight equipment and destroyers, he ordered the destroyer mine layer "Apdiel" to lay mines in the probable path of the enemy. Proceeding at the highest rate of speed she could muster the "Abdiel" encircled the entire German fleet laying her whole complement of mines. The "Ostfriesland" suffered no material damage during the first part of the night. During the night the First Battle Squadron bore the brunt of the British destroyer attacks which the German commanders say were conducted with the utmost bravery and impetuosity. The line of the First Battle Squadron was repeatedly thrown into confusion by the torpedoes fired from the British destroyers. With great determination they closed in on the German ships, one actually succeeding in landing a four-inch shell on the bridge of the "Oldenburg," killing eleven and wounding twelve, mostly officers.

Thus the night passed. Morning came with the "Ostfriesland" steaming quietly along with the rest of her squadron. At about 9:15 o'clock there was a crash of a tremendous explosion as the "Ostfriesland" struck a mine laid by the "Abdiel." A large hole was torn in her side. The bulkheads were strained to

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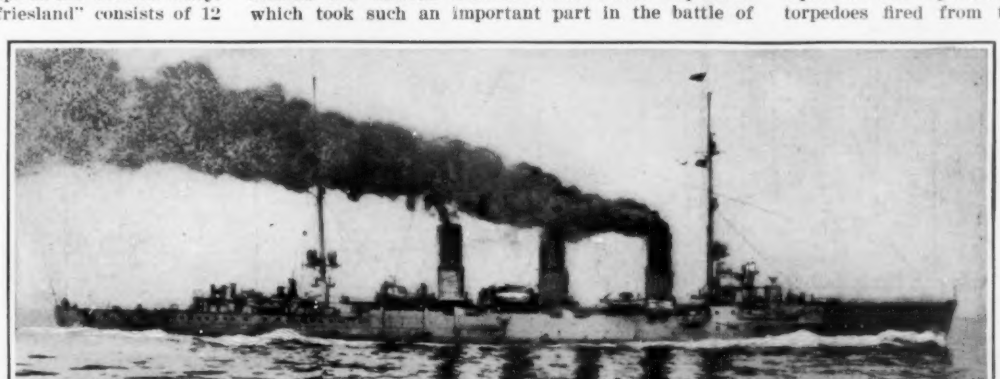

Length: 465 feet. *Beam:* 45.5 feet. *Normal draft:* 17 feet. *Normal displacement:* 5,100 tons. *Speed:* 28.5 knots (contract; engines now disabled). *Armament:* eight 5.9-inch. *Torpedo tubes:* two of 19.7 inches. *Armor:* belt, 5.9-inch; deck, 1.5-inch.

The German scout-cruiser "Frankfurt"

The Architecture of the Atom

Some of the Details of the Langmuir Postulates as to the Atoms

By Oscar R. Foster

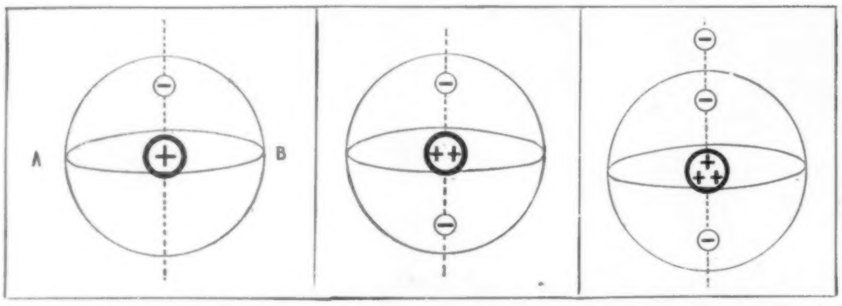

Fig. 1: The hydrogen atom, with one positive charge on the nucleus and one positively charged electron

Fig. 2: The helium atom, with two positive charges and two electrons to balance off with these

Fig. 3: The lithium atom, with three positive charges and the necessary three electrons

The three simplest atoms as Dr. Langmuir sees them, each having a group of electrons corresponding to its atomic number

JOHN DALTON, the famous English chemist, was the first to make the atom the basic unit of scientists. For many years it was regarded as an indivisible unit; for many future years the atom will undoubtedly be the unit for the usual analytical calculations. However our rapidly increasing knowledge of radioactive substances and associated phenomena have led to the belief that the atom is divisible; it is now considered as complex in structure, consisting in some cases of over ninety parts.

Much interest has been aroused among scientific men by a hypothesis which is usually called "The Electron Theory." Briefly stated this theory assumes that the atom is composed of electrically charged particles called electrons; these electrons are situated in definite concentric spheres (or zones) around a central mass of matter. The electrical charges upon the enveloping electrons are negative, while those upon the central mass are positive and equal in number to the negative charges. The entire atom is therefore electrically neutral.

We may roughly visualize an atom as an ultra-microscopic solar system in which the planets are stationary; although the electrons do not revolve around the central mass of matter, they are not rigidly stationary but may move, each one in a small restricted space.

One of the latest of these theories has been elaborated by Dr. Irving Langmuir. His statements are known as the "Langmuir Postulates." This remarkable theory explains some puzzling chemical and physical knowledge of both elements and compounds. The Langmuir Postulates deal with the structure of molecules as well as of atoms, and are therefore of value to the physicist as well as the chemist. Dr. Langmuir has already spoken to the readers of the SCIENTIFIC AMERICAN about his postulates, but there may still be something to say to the layman about them.

In the present paper I shall state in a simple manner the electron theory and its application to elements; in the next paper will be given its application to compounds. The ideas conveyed are those advanced by Dr. Langmuir.

In 1869 Dimitri Ivanovitch Mendeléeff, a Russian chemist, published his remarkable generalization which is known as "The Periodic Law." When studying the chemical elements he arranged them in the order of their ascending atomic weights. Beginning with hydrogen the elements have been numbered consecutively; these figures are called "atomic numbers" and are of prime importance in the theory. We may in fact list all the elements in order of their atomic numbers, in the table of which the first few entries are printed with the accompanying editorial note.

IF we arrange a group of men in the order suggested by their height, the shortest first and the tallest last, the position of each is determined. We are interested, primarily, in the height of each member of the group, in feet and inches; we might also say that John Doe was Number 7 and Richard Roe Number 18 in line. But if we did this, we would not suppose that the numbers 7 and 18 had any special connection with the men who occupied these places.

When we arrange the chemical elements in order of weight, and attach serial numbers to them, however, we are surprised to find that instead of being incidents and accidents, these numbers take on a fundamental importance. The atomic table, thus set forth, runs as follows:

H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	A	K	etc.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	

Starting with this table, Dr. Langmuir has made some extraordinary deductions as to the basis of matter. In this and a following article, Mr. Foster tries to tell what these are in such a way that everybody may understand what it is all about.—THE EDITOR.

We are now ready to picture to ourselves the structure of the atom according to Dr. Langmuir's hypothesis. Referring to the brief statement of the electron theory, we may draw the hydrogen atom as shown in Fig. 1. Situated at the center of an imaginary sphere is a mass of matter with a positive charge of electricity (+). We shall divide our sphere into hemispheres by the plane A—B; in one of these hemispheres is another mass of matter with an equal negative charge (—). It may move about but confines its activities to one hemisphere; we are concerned only with its average position. The question of just what "matter" is we need not discuss in this connection.

The positively charged mass of matter at the center is called "the nucleus"; the negatively charged particle is called "an electron."

Fig. 2 shows us diagrammatically the helium atom. Here we have the nucleus at the center as before but with *two* positive charges; also there are *two* electrons, one in each hemisphere. We must remember that this sphere and its equatorial plane are merely mathematical and are used to locate the relative positions of the nucleus and the electrons, in the same way that the positions of celestial objects are located with reference to the celestial sphere and its equatorial plane.

Fig. 3 shows the structure of the lithium atom and Fig. 4 the neon atom. After we have assigned one electron to each hemisphere we place the third, fourth, etc., electrons in a second outer sphere which is concentric with the first one. To each electron is allotted a portion of space which is indicated by the two vertical planes at 90° to each other.

We may now notice that the number of electrons drawn in the diagrams corresponds to the "atomic numbers." This is our starting point; now we shall state the Langmuir theory very briefly as follows:

(a) The atom of each element is composed of a nucleus and electrons (the hydrogen atom is an exception to the extent that it has only one electron). The number of electrons is in every case given by the atomic number.

(b) The nucleus is surrounded by electrons which are arranged about it in concentric spherical shells. Each electron possesses a negative electrical charge.

(c) The nucleus contains as many positive electrical charges as there are electrons.

We are to remember that the figures are diagramatic and are not intended to show the actual shape of the electrons or the nucleus; their shape is unknown. Also, for the purpose of clearness, we shall omit some of the minor phases of the theory, especially when discussing the arrangement of electrons which are contained in molecules.

Some of the properties of elements may be understood by careful consideration of the structure of atoms. Referring to Fig. 2 we notice it is not only electrically balanced but is also symmetrically arranged; each electron occupying its proper space without trespassing upon the territory of its neighbor, and the nucleus situated between them. With the exception of hydrogen every element has a similar arrangement; that is, its nucleus is surrounded in the first shell by two and only two electrons, the other electrons going into the outer shells.

Considering Fig. 4 we notice that the innermost arrangement of the neon atom is similar to that of

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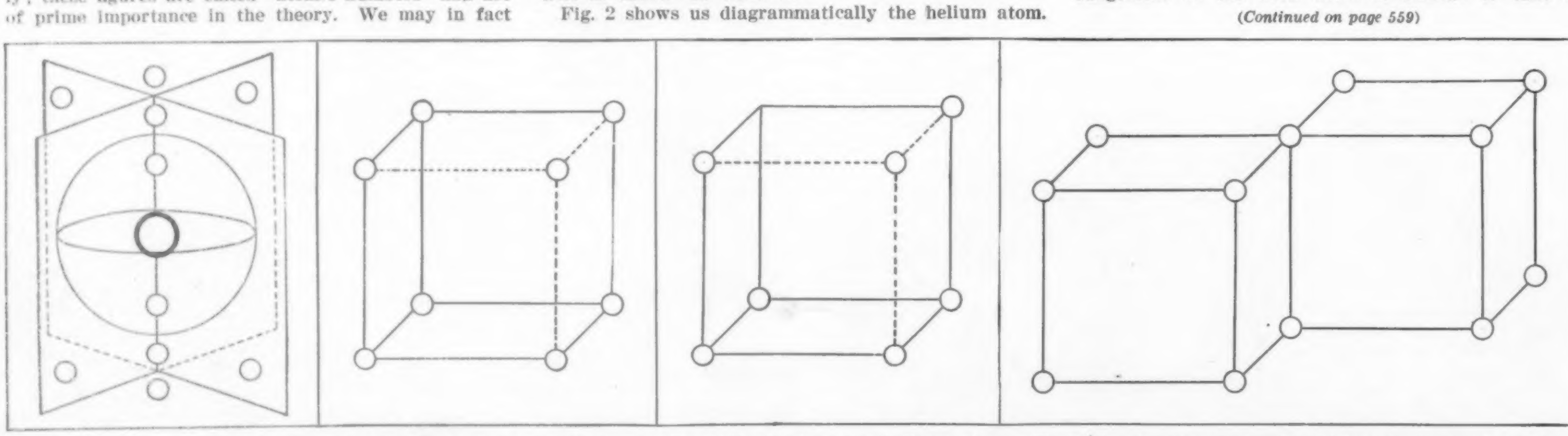


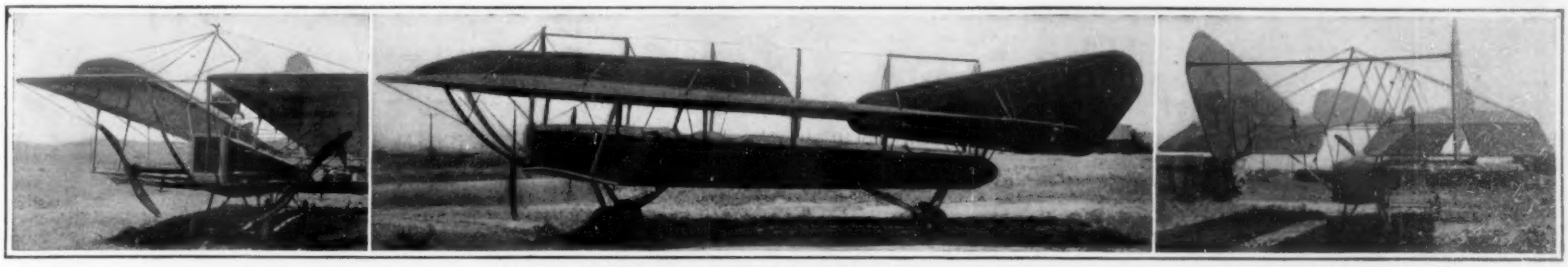
Fig. 4: The more complicated neon atom, with ten positive charges and ten electrons

Fig. 5: The neon atom stripped of reference lines and of nucleus with its two attendant electrons

Fig. 6: The fluorine atom, similarly stripped, shows one blank corner in its fundamental octet

Fig. 7: Two fluorine atoms combined in a molecule, completing the broken octet of both atoms. Octets are usually completed in this way by the process of molecule formation

Diagrams indicating the role played by the "octet" in chemical phenomena. When the octet surrounding the nucleus is complete there is comparative stability; when it is not, action completing it tends to occur



Front, side and rear views of the longitudinal airplane which has been recently flown in a series of test flights in Colorado

The Longitudinal Airplane—Is It Practical?

As the name implies, the wings of the longitudinal airplane lie longitudinally, that is, parallel with the fuselage rather than at right angles to it as in the usual bird-shaped design which is now in universal use. The new machine, developed by Oscar H. Wisenant of Colorado Springs, Colo., is indeed a novelty. It is propelled by twin tractor propellers, one placed at the front end of each plane, and the two are driven by a single motor through a shaft drive. The propellers revolve inwardly, thus doing away with the torque effect. The cambered surface of the planes, it is claimed, retains the washout, which starts a little back of the leading edge and is gradually confined along the length of the plane, creating a lift which continues some distance back of the center of gravity.

In this way, the inventor argues, the greater lift is created on the under side of the plane rather than on the upper side as in the usual crosswise machines. In the wind-tunnel tests with a model weighing 16¼ ounces, having two panels each eight by thirty inches, the cambered surface not exceeding seven-eighths of an inch in depth where the greatest lift was created—about one-third the entire length of the entire panel from the front end—the lift proved to be six to one in a thirty-mile pressure. The lift gradually decreases rearward to two-thirds of the length of the plane, where it vanishes on account of the flattening out of the under surface. The aviator will readily see that this construction enables the machine to climb without perceptably altering its lift.

The longitudinal placing of the planes, it will be seen, tends to reduce head resistance by eliminating struts, wiring and interference with the propeller wash, thus procuring increased speed, according to the inventor. The center of gravity longitudinally is well forward, a trifle in front of the center of lift, practically the same as in the dirigible. This machine has recently proved its automatic stability in actual flight, showing it incapable of going into a side slip. With a gliding angle of 1 to 28, according to the inventor, the machine is practically assured a safe landing.

An elevator is attached to the extreme rear end of each plane, and by means of these elevators lateral and longitudinal balance is maintained. They are controlled by a joystick, the movement of the stick being forward and backward for longitudinal control and from side to side for lateral control. This sidewise motion causes the elevators to work alternately up and down—that is, in tipping to the left the stick is pressed to the right, making the left elevator go up and the right down. This is, of course, practically the same as the action of the ailerons, in the usual type of machine. Straightaway steering is practically the same as in the crosswise plane, being controlled by a rudder-bar operating the two rudders fixed centrally at the rear end of the planes and working in conjunction.

Attached to the lower part of the body under the front end of the main planes, a little ahead of the center of gravity and in the line of force are two small wings having a slight dihedral angle. These are equipped with ailerons operated by a separate joystick fixed to the right-hand side of the pilot's seat. By a forward or backward movement of the stick the pilot is able to lower or raise the ailerons either together or alternately, which gives a lateral control, but not in conjunction with the rear elevators. In this way the machine is provided with two distinct controls. By lowering the ailerons, these small wings are made to add head resistance, enabling them to act as a brake in case of forced landing.

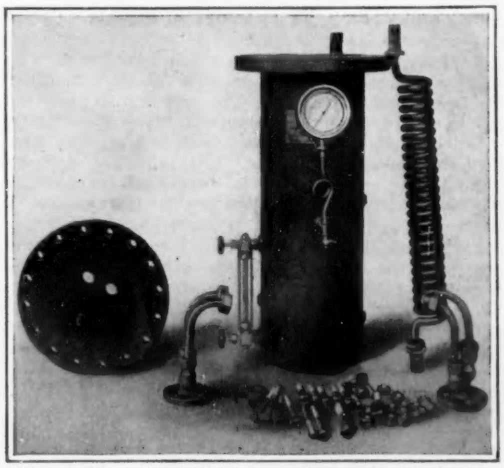
Like all inventors endeavoring to revolutionize the standardized practice of any given art, Wisenant has had a long, long climb to attain his present realization of a full-sized machine. During the war the War Department took supervision of his work and forbade any publicity. The work went on, greatly aided by the Federal aviation authorities.

In tests with a 9-horse-power motor, the longitudinal airplane here depicted has flown at low levels and taxied over rough terrain at 50 miles an hour. In a forced landing it lit on its feet "as surely as a cat," according to reports. A 300-horse-power Hispano-Suiza motor is to be installed in this plane in the near future, and the new performances are almost certain to be of considerable interest. However, it is difficult at present to make definite promises of what the longitudinal airplane may do, and whether this type may in time come to be something more than a freak among aircraft.

This gasoline locomotive takes the place of the horses that were formerly used to haul the diminutive car shown

Holland's Tramcar Tractors

In the little city of Apeldoorn, Holland, the automobile has been put to a new use, as shown in the accompanying illustration. Two automobile power plants, each in its own hood, as shown, are mounted on a small four-wheeled truck and drive the wheels through a simple chain transmission, thus making a gasoline locomotive. In this manner the former horses are replaced, and the gasoline locomotive hauls one or two tramcars through the city streets with a considerable gain in economy and satisfactory operation.



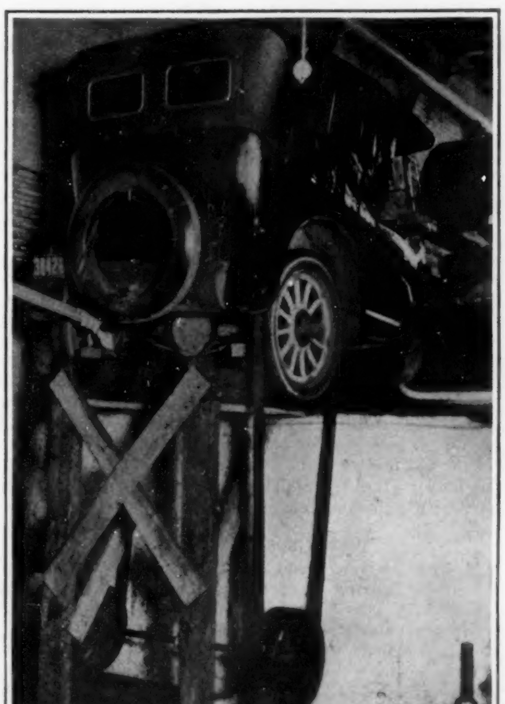
Oil for oil-burning boilers is pre-heated in this device, here shown taken down

An Oil Heater for Oil-Fired Boilers

In most systems of oil burning, it is found necessary to preheat the oil before it goes to the burners, in order to insure the proper vaporization and, therefore, good combustion of the fuel. In this connection there has been recently developed the fuel-oil heater shown in the accompanying illustration, which is designed for the preheating of oil before it is supplied to the burners under power-plant boilers.

This fuel-oil heater is constructed of cast-iron shell suitable for a working steam-pressure of 250 pounds per square inch, and the heating surface through which the oil passes consists of helical piping of seamless drawn-steel tubing, attached to the outside manifolds by metal-to-metal joints free from brazing. High pressure steam in the shell is used as the heating medium. It is necessary to use high pressure steam because a high final temperature of oil is required. The condensation from this high pressure steam is returned to the boilers and it is imperative that there shall be no contamination of this condensation by oil leakage.

The present fuel-oil heater is designed to prevent contamination of this condensation through oil leaks. All oil joints are outside of the shell and there is, accordingly, no possibility of leakage of oil into the steam space through faulty joints. The efficiency of this unit is claimed to be extremely high, inasmuch as the helical coil construction insures the constant agitation of the oil passing through the heating surface and thus the maximum rate of heat transfer from the steam to the oil is certain to be attained under all conditions of operation.



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A factory was supplied with light and power by this touring car during the coal shortage

An Automobile That Ran a Factory

Some time ago there appeared in these columns an account of how motor trucks had been running the machinery in several factories during the coal shortage. It seems that motor trucks, which are obviously powerful and quite adapted to work of that kind, have not been alone in this matter of improvised power plants. Our attention is called to a plant in Chicago, engaged in making reducing valves for the Government, which operated on the power of a standard touring car for twelve consecutive days without a letup, except when the day and night shifts changed off.

When the coal shortage threatend to tie up the plant, the president decided to press his touring car into service. It was rigged up in the factory as shown in the accompanying illustration with belts placed around the rear wheels and to a line shaft, in order to drive a 220-volt generator. This generator supplied current for lighting and also power for running the various milling, grinding, drilling and automatic machinery of numerous character throughout the factory.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Names of Dyes

MR. J. MERRITT MATTHEWS in the *Color Trade Journal* for January presents in an interesting way a discussion of the nomenclature of dyestuffs. While the chemical name for these compounds is really a formula easily understood by the organic chemist, it appears to be but a jumble to the layman and is usually so unpronounceable as to be impossible as a trade name. In the early days the name usually had reference to a particular quality of tone or to the use of the dye, such as cloth red. In one period the names of prominent people were employed, such as Victoria blue, and later an effort was made to indicate the chemical name of the dyes; for example, methyl violet. With the rapid increase in the number of dyes and of manufacturers all sorts of names were introduced, and in an effort to establish their own lines manufacturers unfortunately often gave different names to the same product. An instance is given where seven names, each from a different manufacturer, were applied to direct cotton blue. The next step was the adoption of class names to the different lines of a firm's product and this has been followed by new concerns entering the field. Thus Erie, pontamine, amanil, duranthrene, chloranthrene and caledon, are new to commerce.

The letters often noted following the names of dyestuffs are usually private marks for the use of the manufacturer in identifying the color in question. *X* is often used to indicate a concentrated dye, *W* usually designates one for wool, *L* a light fast type, and *S* those especially soluble. The names are still further complicated by the use of mixed dyes. The article is accompanied by an extensive table of group names indicating the class of dye and the manufacturer.

Composition of the Body

"DYESTUFFS" is responsible for a statement with reference to the constituents of the human body expressed in a unique manner. Taking a man weighing 150 pounds and in normal health, we find that he will contain 54 ounces of phosphorus, which is enough to make 600,000 matches, enough fat to make a 15-pound candle, and his 22 pounds of carbon would make 180 dozen of lead pencils or carbons for a number of arc lamps. There is enough iron to produce a spike large enough to hold his weight, and there is approximately 3,500 cubic feet of gas, oxygen, hydrogen and nitrogen, which would be worth nearly $4.50 for illuminating purposes. If you were to distill this man, the result would be nine and a half gallons of water. The body also contains two ounces of lime, 20 spoonfuls of salt, and considerable quantities of starch, chloride of potassium, magnesium, sulphur, and hydrochloride acid.

It is an astonishing fact that a thousand eggs with their shells have the material essential to the making of a 150-pound man, in all detail from cerebral tissue to toe nails.

A New Alloy

NEWS comes that an Italian engineer has succeeded in finding a new combination of zinc and copper which is stronger than steel and less corrosive than copper. The most important characteristics of the new alloy, which has been named "Biak-metal," are the highest known breaking point, the highest limit of elasticity, perfect homogeneity and higher resistance to both beating and chemical action. It has been stated that it can be successfully cast, machined, rolled, forged, drawn, and stamped. It is expected that it will prove an acceptable substitute for steel, brass, and aluminum, in many instances.

Synthesis

REFERENCE is frequently made to a laboratory represented by every growing plant which is able to synthesize cellulose, chlorophyll, and other substances, from the chemicals in the soil, moisture, carbon dioxide, and sunlight. Not only is the plant able to perform this work, but in doing so it develops physical energy that is surprising in its extent. Professor Clark of the Massachusetts Agricultural College has demonstrated this by harnessing a growing squash, which was so bound about by iron that it could only grow by pushing upward against the long arm of the lever at the other end of which weights were suspended. The record shows that on August 21 the squash was exerting a pressure equal to lifting 60 pounds. This increased to 1,400 pounds by September 15, 3,120 pounds by October 18, and 5,000 pounds by the last day of that month. At this point the experiment had to be discontinued, since the iron bands began to cut into the squash.

Other investigators have noted the pressure in root tips of large trees in the springtime when the sap begins to flow and must be pushed upward in columns of great height. Some of these tender root tips have been shown to develop a pressure of 30 pounds per square inch and indeed the physical energy in the sap of the plant has been estimated at fourteen times that of blood in a human being.

Lactic Acid

THE United States Tariff Commission has just published another of its chapters on acids and chemicals, giving information primarily collected for the use of Congress in tariff legislation. The technical grades of lactic acid are used chiefly in tanning and dyeing. In the tanning process the chemicals used to remove the hair from the hide are ordinarily removed from it by soaking in what the trade terms a bran drench prepared by the fermentation of bran and water. This fermentation results in a mixture of lactic, acetic and butyric acids. Commercial lactic acid is very much more convenient for this use which together with sodium or potassium lactate accounts for more than half the lactic acid production. The acid is also used as a substitute for acetic in dyeing and printing operations.

Edible lactic acid may soon become a rival of citric acid for beverage purposes. It is also useful in the baking industry, especially in breads involving certain wheat substitutes. It also has a certain use in medicine.

Lactic acid is prepared by the fermentation of glucose prepared from corn starch or molasses. But the demand for these materials to be used as food has made cheaper materials necessary. Spoiled corn and potatoes are often used, as is waste vegetable ivory from button manufacture converted by acid treatment into fermentable carbo-hydrate. In 1917 the lactic acid produced in this country exceeded 1,900,000 pounds.

A New Anesthetic

A HIGHLY refined ether, modified by the addition of certain gases, has been found superior as an anesthetic. It eliminates pain without loss of consciousness and reduces to a minimum the nausea that generally follows the use of ether. The ability to produce insensibility to pain without loss of consciousness opens up an entirely new field, including many operations which are now performed without any attempt to eliminate pain. Certain types of dental operations and obstetrical cases illustrate the point as well as the changing of packing and dressing of severe wounds.

Colloidal Coal

AN efficient and economical substitute for both coal and oil as a steamship fuel seems to have been developed by the application of colloidal chemistry, a branch of the science which is attracting great attention at the present time. It has been found possible to suspend thirty to forty per cent of coal for months in fuel oil, a so-called binder being used to bring the coal into and keep it in a colloidal state. One operation consists in pulverizing the coal to a point where 35 per cent will pass through a 200 mesh screen. One type of fuel results from the combination of 45 per cent of oil, 20 per cent of the binder, and 35 per cent of pulverized coal. This results in a saving of about one-half in fuel oil and increases the heat values per barrel at the same time effecting considerable economy.

New Uses for Concrete

IN hydroelectric insulations the stator frame and thrust bearing supports are so large in certain alternating current generators that manufacturing equipment and shipping facilities are often seriously taxed. Experiments have therefore been undertaken to determine to what extent concrete may be used for these purposes and it now appears practicable to build these members for large size horizontal shaft machines of concrete. This is due to advanced knowledge of aggregates and cement and the methods of combining them with suitable amounts of water to produce not only uniform strength in all parts of a large size concrete structure, but also to produce duplicate parts as may be required. The resulting product, which may or may not be reinforced with metal, has great strength and consequently may be safely used in many places where metal has heretofore been considered the only safe possibility.

Insurance for Chemical Plants

MR. W. D. GRIER has recently made a study of chemical manufacturing plants from the standpoint of insurance companies with the result that a number of commonly occurring defects have been found, among which the following may be noted. Methods of storing are often defective and piping is so installed that there is great risk of breaks occurring in connections. Where fuel oil systems are employed, defects are frequently found and apparatus directly heated has been seen provided with defective furnaces. Oil baths sometimes involve great risks, while nitration is occasionally carried on without sufficient care. Methods of handling hazardous materials have not been carefully studied in each case, while defective ventilation where inflammable fumes occur is frequently the cause of considerable damage. Grinding processes are known to involve fire risks and because of the corrosive nature of the atmosphere, electric insulation if often attacked, leads to fires.

As a result of this study *Chemical and Metallurgical Engineering* informs us that a chemical department has now been organized by an insurance company for the purpose of affording fire-protection engineering service to the chemical industries. This is a unique development in insurance practice.

Rust Proofing

THERE is a constant demand for cheap, simple treatments of iron and steel which will give uniform coatings which are rust-proof. Sherardizing and galvanizing are well known, as is also the Bower-Barff process which produces a surface composed mainly of Fe_3O_4. To this list may be added the recently improved phosphatic coatings which seem to be cheaper than the other processes and to give a uniformity of coating that is much in its favor.

The processing solution is composed of phosphoric acid, iron phosphate and manganese dioxide. The bath must be used under controlled conditions and is kept in constant circulation. The articles are immersed for from one to two and a half hours at a temperature of 210-212°F. The treatment is considered finished when the evolution of gas ceases, whereupon the work is dried and dipped in a paraffine oil mixture and afterwards set upon pans or racks to drain. The materials treated are said to be resistant to rust and stand exposures very satisfactorily. The process is particularly adapted for the treatment of tools, motor parts, typewriter parts, and other similar pieces which should be rust proof and at the same time attractive in appearance.

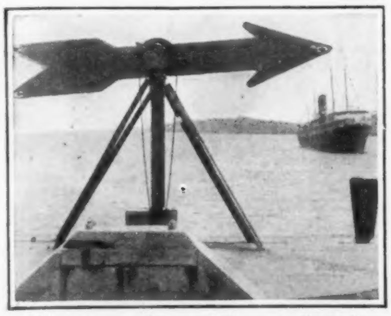
New Coal Tar Products

ANNOUNCEMENT has been made that coal tar can now be made to yield tartaric acid and other important organic compounds by building up the various substances from maleic acid obtained from benzol. Heretofore the whole source of maleic acid has been the juices of certain plants and fruits and while it has been separated from these sources, the cost has been so high that it could not be put upon the market. Tartaric and citric acids have been fruit products and lactic acid has heretofore been made by the fermentation of milk or from starches converted into fermentable carbohydrates by an acid treatment.

The process now announced involves passing benzol vapor mixed with air over a catalyzer. The resulting maleic acid is the base or starting point for a variety of treatments yielding enormous industrially important materials. These include new dyes, medicinals, and perfumes.

Carbon from Gas

IT is reported that natural gas is being used as a source for carbon electrodes in localities where the supply of gas is too small for light, heat or power. The gas is cracked by passing it through pipes heated so as to produce soot and tar from the gas. This mixture is formed and baked at the proper temperature to yield an electrode with the amount of tar desired.



This arrow points out the way through the Panama Canal locks

Animated Arrows That Point Out the Way

THE handling of shipping through the Panama Canal requires traffic management of no mean degree; indeed, the problem is in many respects not unlike that of the busy thoroughfare with its thousands of vehicles. True, there are not so many ships to handle, but then again a ship is many times more difficult to handle than any vehicle.

So it is not surprising to find a very complete system of traffic signals in use at the Panama Canal. One of these signals is shown in the accompanying illustration. It is in the form of a pivoted arrow, operated by a chain control. At night the arrow is illuminated with three electric lamps. The arrow can be pointed in either direction, so as to indicate to steamship pilots which path to take through the locks of the canal.

Is a Trolley Car Coming?

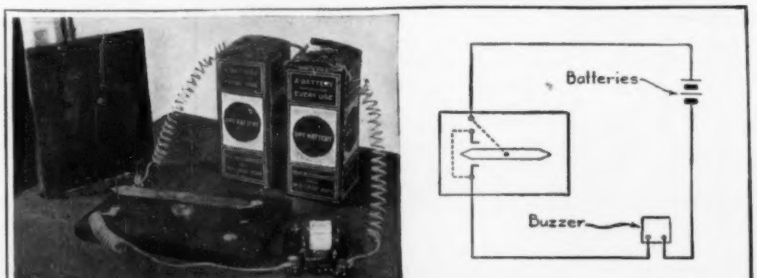
THE powerful magnetic field of a trolley car's motors spreads over a surprisingly large area. Indeed, the ordinary compass will respond to such a magnetic field while the trolley car is still a considerable distance away—almost a quarter mile away, in the case of the large interurban cars with four motors.

Taking advantage of this simple fact, a young electrical experimenter has arranged what he terms the "trolley car detector," shown in the accompanying illustration. A strip of good steel, with a hole in the center, is mounted in such a way as to be free to swing as a compass. One end of the strip is placed between two upright copper wires, and the connections with two dry cells and a buzzer are made as shown in the wiring diagram.

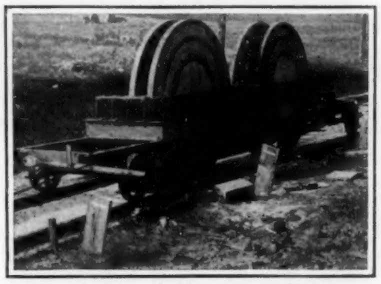
The operation of this "detector" is as simple as its construction. Upon the approach of a trolley car, the magnetized strip, acting as a compass, is affected and therefore turns one way or the other; and as it leaves its normal position it makes contact with one of the upright contacts, thus completing the circuit and operating the buzzer.

It is pointed out that the sensitiveness of this "detector" depends entirely on the quality of the compass. Thus if a small compass is employed, the range of detection is greatly increased. Then again, for really good results a sensitive relay should be employed, with the buzzer and its batteries in the local or secondary circuit; for it is obvious that the delicate contact made between strip and upright contact is not always positive enough to operate the buzzer.

One more feature of novelty in this case, is the "magnetic screen." Obviously, the compass is affected by a car coming in either direction. In order to make it respond to cars going in one direction only, the magnetic screen is brought into play. This consists simply of a piece of sheet iron, shown at the left of the batteries. By placing the screen in the path of the undesired magnetic waves, the apparatus is rendered sensitive to waves from all other directions.—By *George Gaulois.*



The trolley car detector which indicates the approach of a car or electric train by the magnetic waves emitted



The 1,000-pound wheels are rolled over pavements to test their wearing qualities

Testing Road Surfaces by Wearing Them Out

HOW long will road-surfacing material stand up under constant wear from heavy motor trucks and what is the relative durability of varying types of pavements when subjected to all sorts of traffic? If you are a highway engineer, doubtless these questions can be answered in a general way. The average citizen distinguishes an improved highway from an unimproved stretch of road by the number of ruts encountered by actual contact.

Haphazard information is inadequate when the Federal Government has vested within your authority the judicious expenditure of $269,000,000 in three years. So the U. S. Bureau of Public Roads wants exacting data on 49 varying types of pavements in the execution of the three-year road building program. A special device has been installed at the Arlington Experimental Farm, U. S. Department of Agriculture, to determine the wearing strength of the different road-surfacing materials.

The experimental road, containing the 49 different types of pavements, is 400 feet long. The various groupings embrace concrete containing varying kinds of aggregate, brick of different percentages of wear, sand with Portland cement grout, and also bituminous filler. The types of construction have likewise been varied, including sand cushion monolithic and semi-monolithic. Stone block from scattering sections of the United States is being tested, laid with bituminous filler as well as grout filler.

A specially designed machine, operated to and fro over this road of divers materials, reflects the relative wearing strength of the different types of pavements. The machine is drawn by a cable, which in turn is operated by a 30-horse-power stationary kerosene engine. The machine consists of five heavy cast-iron wheels, only four of which are visible in the accompanying illustration. Each wheel weighs 1,000 pounds and the five are arranged to roll independently of one another. Their spacing permits the wearing of the pavement over a width of 12 inches.

Once this series of experiments has progressed far enough to warrant conclusions, road builders should have available definite information as to the wearing qualities of varying types of pavement.—By *S. R. Winters.*

Painting an Orchard with Insect Spray

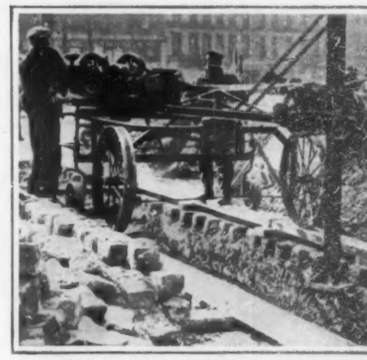
CURRENT practice in painting or whitewashing the interior of tunnels calls for a spraying machine that travels through the tube and deposits the coating of liquid as it goes. Poets and others with an eye for analogy of form often point out that forests and orchards give an effect of a tunnel of trees; so when it becomes necessary to paint such a tunnel, why not use the same procedure? Our photograph shows a spraying machine developed and now in use in England, which works out this suggestion. It travels in the open ground between the rows of trees, and shoots sprays of insecticide sideways and upward, which depend for their efficacy upon the very tunnel-like character of the lane through which the vehicle moves. The cart which we illustrate is a horse-drawn one, but there is of course no reason why it could not be motorized where spraying is to be undertaken on a sufficient scale. The

The last word in spraying orchards

spraying nozzles are so constructed that they operate only when the vehicle is in motion.—By *Ralph Howard.*

Tamping Machine to Expedite Filling

IN the keen search for means to get necessary work done without delay and at reasonable cost in the face of rising wage scales and labor shortage, machinery is coming more and more into play. Even in Europe, where common labor has always been notoriously cheap and easy to get, the pinch is felt and mechanical devices are coming into very wide use in place of the good old engine that burns elbow grease. The photograph reproduced herewith gives one interesting example of this sort of thing. It shows a machine for tamping the earth that is put back into excavations. This machine is manufactured in Lansing, Mich., and we show it at work on a repaving job in gay Paree, the officials of the French capital having recognized



Filling a ditch with the aid of a mechanical tamper

its great utility. In design it is simple enough, consisting merely of an engine and a rack-and-pinion gear on which the tamping head descends and ascends. It strikes a much more forceful blow than a man, and one that covers a much larger area; and in this way it makes up for any deficiency in frequency. It is found that with this machine steadily at work tamping the dirt, the process of filling goes forward at a vastly accelerated rate. Perfect mobility of the machine is secured by the plank walk on either side of the ditch along which it rolls to any desired longitude, while the man at the far end makes the necessary adjustment back and forth across the excavation by swinging the entire machine around like an artillery piece; and finally the vertical adjustment for a shallow or a deep hole is effected by shifting the long tamping bar in its rack.—By *H. C. Hardy.*

Automatic Drainage Gates for the Farmer

WATER is all right in its place but when a farmer finds it all over a field that he wants to plow up for an early planting he feels a bit like saying things. But he will not be bothered that way if he installs one of the new automatic drainage gates made by a California manufacturer.

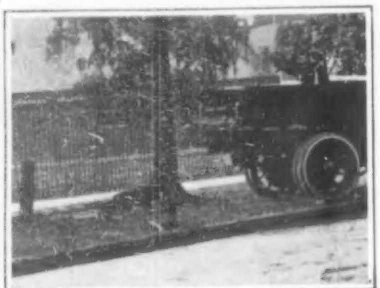
A drainage pipe open at both ends is of service only as long as the water level at the intake end is higher than at the outlet end. But as soon as the water on the outlet end of the pipe finds a higher level there is going to be trouble and the area which is being drained will get another bath. With this new automatic gate installed on the outlet end of a drainage pipe such a condition is eliminated. Water will flow through such an installation only one way and that is the right way. As soon as the water in the ditch receiving the drainage from the flooded area tries to back up through the pipe the gates close and close tight. Yet the slightest pressure from the inside of the pipe will cause the gate to open. A difference in head of a few hundredths of an inch will automatically open or close the gate. The gate seats are machined and ground so that there will be a perfect fit.—By *Allen P. Child.*

Automatic drainage gates closed to keep water from backing up in drained area

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Truck equipment for hauling cable out of its conduit

The Cable Truck

AMONG the many uses of motor trucks should be added its ability to make short work of what formerly was a process requiring the services of a number of men and horses. A winch-equipped truck in the service of the electric light department of a large city is shown in the accompanying illustration, drawing in an electric cable through the underground conduit. The equipment needed is very simple. A special stand carrying pulleys to guide the cable is placed in the manhole and a guide-pulley is mounted on the truck rear-end to prevent abrasion of the hauling cable as it passes to the engine-driven winch at the front end of the body. The truck not only serves to move the workmen, tools and large reels of cable to the job but also assists in the actual work of running the cable from manhole to manhole.

Mobile Scale-Testing Outfit

OPERATING in the principal coal-mining districts of the country, the two mine-scale-testing motor trucks of the United States Bureau of Standards have displaced the former practice of hiring private conveyance or shipping the experimental equipment by rail from one objective to another. The two Government-owned trucks are each equipped with 2,500 pounds of 50-pound weights, a portable balance, and other essential apparatus in keeping tab on scales used in weighing coal at the production centers. Two men are assigned in charge of each truck.

While the body of the motor-driven vehicle is especially constructed for carrying the weights and other accessories, the chassis is of a light aviation one-ton truck model. The ability of the design to undergo extremely difficult service, not altogether dissimilar to that placed on motor power in overseas duty, renders it valuable as a conveyance in mining areas. Almost impassable roads and seemingly inaccessible territory are not uncommon conditions where a nation's fuel is extracted from the earth.

How much Government-owned motor trucks are instrumental in averting or amicably settling disputes between coal operators and miners by their speedy conveyance of Uncle Sam's referees may be imagined. The Commercial Scales Section of the Bureau of Standards frequently acts as adjudicator in differences between operators and miners where discrepancies in weights have arisen. Sometimes the distrust between mining employers and employes as to weights has been overcome by the unbiased judgment of the Government, occasionally pending strikes are peacefully adjusted, and once in a while Uncle Sam has discovered serious inaccuracies in mining scales, resulting in grand jury investigations, which ultimately imposed heavy fines or sent the operators to jail.

Industrial tractor with trailer in an automobile factory

Truck engine co-operating with electric current and steam plant to hustle along a big contracting job'

The Contractor's Power Needs

THE modern building contractor plays no favorites in his use of power when it comes to getting his work done economically and with the proper degree of speed. The accompanying photograph is an exceptionally interesting one as it shows contracting equipment utilizing three radically different forms of power. The centrifugal pump in the foreground is driven by an electric motor belted to it and taking its energizing current from a central station. The giant excavating shovel that is so useful in removing earth has its own self-contained steam power plant and can be moved from point to point under its own power. The dump body equipped motor trucks used for carrying away the excavated earth are of five-ton capacity and are propelled with internal combustion engine power. This exemplifies, to a marked degree, the dependence placed on mechanical power by various industries for doing big work in a big way. The motor truck is one of the best and most useful pieces of mechanism in the contractor's equipment and is almost exclusively used at the present time by modern contractors for all transportation work.

Increasing Use of Industrial Tractors

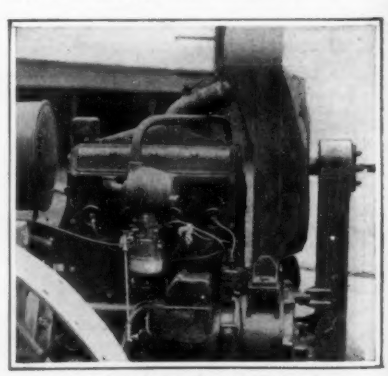
THE modern manufacturing plant of any pretensions is so organized that goods in process must go through a number of departments before they are finished because certain specialized machinery is grouped in each department that is capable of performing only certain operations. The transportation of parts in process was formerly accomplished by small trucks hauled by boys or men and a large number was needed to keep things moving because of their relatively low capacity which was limited by the pushing or pulling ability of a human being. Such hauling could not fail to be expensive in more ways than one. It was not only very costly, due to the number of men required, but at times the productiveness of entire departments would be curtailed by slow delivery of work.

The industrial tractor shown is in service in a large automobile plant and it will be apparent that it can haul a large amount of material on one trip because its load-carrying body-capacity may be augmented by one or more loaded trailers. As the power is furnished by a gasoline engine there is no lost time due to charging storage batteries and the outfit can be kept on the job as long as necessary. Heavy materials may be moved economically from department to department, and as the engine is powerful and the tractor and trailers are equipped with rubber tires, goods may be moved in the yards as well as in buildings.

Tractor Power-Plant Placing

IT is interesting to note in the newer forms of light tractors and motor cultivators how tractor engineers are following automobile practice as relates to power-plant design and location and also in the methods of speed changing and final drive. The location of the compact four-cylinder power plant at the front end of the chassis behind a substantial radiator is clearly shown in the accompanying photograph of the front end of a late-model motor cultivator. The location of the carburetion and ignition units is the same as in a motor car and the engine is a medium-speed type based on automobile rather than traction-engine practice. Attention is directed to the electrical generator located under the carburetor which furnishes current for ignition and lighting and also for keeping charged the storage battery that furnishes current for the electric starting motor which can just be seen through the wheel spokes.

Motorized equipment for testing mine-scales



Present practice in locating the power plant of the tractor

Continued on following pages

Continued from preceding page

Roll of White Truck Fleets

	1910	1911	1912	1913	1914	1915	1916	1917	1918	To-day
Brooklyn Alcatraz Asphalt Co.	0	0	0	2	9	9	11	11	11	11
Brooklyn Daily Eagle	0	0	0	0	0	0	0	6	9	11
Bry-Block Mercantile Co.	0	0	0	0	0	0	0	0	10	10
M. Burkhardt Brewing Co.	0	0	0	2	2	2	5	5	5	11
P. H. Butler Company	0	0	0	1	1	4	6	11	12	12
Cable Draper Baking Company	0	0	0	0	0	0	0	0	0	10
Caddo Parish, Louisiana	0	0	0	0	0	0	0	2	13	13
California Baking Company	0	0	0	0	0	0	0	13	17	21
Calif. Central Creameries, Inc.	0	0	0	0	0	0	0	6	6	11
California Packing Corp.	0	0	0	0	0	0	0	4	7	11
California Truck Company	0	0	0	0	0	2	3	3	4	17
J. Calvert's Sons	0	0	0	0	0	0	0	0	0	11
Canfield Oil Company	0	0	0	0	0	0	0	0	0	10
Canton Storage & Transfer Co.	0	0	0	0	0	0	1	7	9	11
Carolina Public Service Co.	0	0	0	0	0	0	0	7	11	11
Carstens Packing Company	0	0	0	0	0	0	0	0	0	10
Carter Oil Company	0	0	0	1	1	1	1	1	4	10
W. A. Chambers Company	0	0	0	0	0	0	0	2	5	12
Chapin-Sacks Corporation	0	0	0	0	0	0	0	10	21	28
Chattanooga Chero-Cola Bot. Co.	0	0	0	0	0	0	0	1	2	12
*Chero-Cola Bottling Companies	0	0	0	0	4	6	30	62	96	179
The Chero-Cola Company	0	0	0	0	0	0	0	0	1	32
City of Chicago	0	0	0	1	4	10	27	38	47	47
Chicago Fire Insurance Board	0	0	5	11	13	13	13	13	13	13
Cincinnati Coca Cola Bott. Co.	0	0	0	0	0	0	0	1	1	16
Cincinnati Motor Terminals Co.	0	0	0	0	0	0	0	2	2	16
City Ice Delivery Company	0	1	1	3	3	3	5	8	8	11
Clark's Bus Line	0	0	0	0	0	0	0	11	12	12
Clearing House Parcel Del. Co.	0	0	0	0	0	3	10	10	14	15
City of Cleveland	0	2	7	14	15	19	23	32	36	43
Cleveland-Akron Bag Company	6	7	9	14	15	19	21	39	45	54
Cleveland-Akron Bus Line Co.	0	0	0	0	0	0	0	0	0	10
Cleveland Build. Sup. & Brick Co.	0	1	1	3	4	7	10	14	19	51
Cleveland Coca Cola Bott. Co.	0	0	0	0	0	0	0	0	0	21
Cleveland Electric Illum. Co.	0	0	0	0	0	6	17	23	23	40
The Cleveland Press	0	0	0	0	0	0	0	0	0	10
Cleveland Provision Company	0	1	2	3	7	7	11	13	15	29
Cleveland Transfer Company	0	0	0	0	0	0	1	19	19	20
Cleveland & Sandusky Brew. Co.	0	0	1	1	2	3	10	15	17	24
*Coca Cola Bottling Companies	0	3	6	11	24	34	67	108	164	204
The Coca Cola Company	0	0	0	0	0	0	0	5	5	15
The Coca Cola Co. (Canada)	0	0	0	0	0	0	0	1	2	13
R. H. Comey Company	0	0	0	0	0	1	4	9	9	12
Commercial Transfer Co.	0	0	0	0	0	0	2	5	7	10
Cen. Gas, El. Light & Power Co.	2	3	6	8	11	12	12	12	12	11
Consolidated Rendering Co.	0	0	0	0	0	0	4	7	17	17
Continental Oil Company	0	1	2	2	3	4	19	25	34	38
Crew Levick Company	0	0	0	0	0	0	2	4	5	25
Crystal Park Lumber Co.	0	0	0	0	0	1	3	6	6	12
Cuban Government	0	0	0	0	0	0	0	0	10	10
Cudahy Packing Company	0	0	2	6	8	10	21	24	27	42
Culbertson Bros. Company	0	0	0	0	0	0	1	8	12	11
Dannemiller Grocery Co.	0	0	0	0	0	3	6	12	12	12
Dominion of Canada	0	0	0	0	43	43	43	43	43	43
E. I. DuPont de Nemours Pdr. Co.	0	0	0	0	0	0	1	16	20	20
East Ohio Gas Company	0	0	0	1	3	5	5	10	11	11
Eastern Torpedo Company	0	0	0	1	2	7	10	15	20	25
T. Eaton Company, Ltd.	0	5	13	14	15	15	20	20	20	25
Emerick Motor Bus Company	0	0	0	1	5	9	11	14	16	16
Empire Gas & Fuel Company	0	0	0	0	0	0	0	33	61	77
Erie Service Company	0	0	0	0	0	0	0	0	0	11
The Fairbanks Company	0	0	0	0	0	0	0	0	0	10
Fairmont Creamery Co.	0	0	0	0	0	0	0	0	1	13
Owen H. Fay Livery Company	0	0	0	23	23	23	23	24	24	24
Fenway Garage Company	0	0	19	19	29	29	39	39	30	37
Firestone Tire & Rubber Co.	0	0	0	1	1	2	6	12	16	18
Fly & Hobson Company	0	0	0	0	0	0	0	10	10	10
Foster & Kleiser, Inc.	0	2	4	4	8	10	10	10	10	10
Frank & Seder	0	0	0	1	1	1	2	2	2	19
Harry V. Franks	0	0	0	0	0	0	6	16	16	16
Frederick & Nelson, Inc.	0	0	0	3	7	9	10	13	18	26
Freedom Oil Works Company	0	0	0	0	0	0	0	0	16	17
General Baking Company	0	0	0	1	1	1	1	10	25	43
General Cigar Company	0	0	0	0	0	0	0	0	1	12
General Petroleum Company	0	0	0	1	0	2	4	8	15	34

	1910	1911	1912	1913	1914	1915	1916	1917	1918	To-day
Georgia Fruit Exchange	0	0	0	0	0	0	0	12	37	33
Georgia Railway & Power Co.	0	0	1	3	7	7	18	22	24	24
Gimbel Bros., Inc., (Milwaukee)	0	0	0	2	3	4	6	7	7	13
Gimbel Brothers (New York)	0	20	26	46	59	59	62	62	71	71
Gimbel Brothers (Philadelphia)	0	0	0	0	0	0	0	0	7	13
Glacier Park Transportation Co.	0	0	0	0	10	20	22	23	23	24
Globe Grain & Milling Co.	0	0	1	2	2	2	3	3	5	16
Adolf Gobel, Inc.	0	0	0	0	0	0	0	10	30	35
J. Goldsmith & Sons Company	0	0	3	4	5	5	7	12	12	12
B. F. Goodrich Company	4	6	9	11	12	17	19	22	25	28
Goodyear Tire & Rubber Co.	0	0	0	0	0	0	3	10	15	22
Gray Construction Company	0	0	0	0	0	1	3	10	12	12
Great Northern Paper Company	0	0	0	1	1	11	13	18	18	19
Greenfield El. Light & Power Co.	0	3	6	9	10	11	13	13	14	14
Greenville Coca Cola Bott. Co.	0	0	0	0	0	0	2	6	6	10
Gulf Refining Company	0	1	9	29	81	172	463	563	663	755
Halle Brothers Company	0	0	0	0	0	0	12	13	13	15
A. Hamburger & Sons, Inc.	0	0	0	0	0	0	0	0	0	25
James A. Hamilton	0	0	0	2	3	4	5	6	8	10
The Hardware & Supply Co.	0	0	0	0	1	2	3	4	5	10
Fred Harvey	0	0	0	0	0	0	0	0	0	15
Haverty Furniture Company	0	0	0	0	2	6	7	12	18	18
Hawaii County, T. H.	0	0	2	9	9	9	10	11	16	17
H. J. Heinz Company	0	0	0	0	0	0	16	19	26	35
The Higbee Company	2	4	5	6	10	10	10	12	12	16
Hochschild, Kohn & Co.	0	1	3	5	6	8	10	9	12	15
Joseph Horne Company	5	12	15	24	33	39	42	42	42	41
J. L. Hudson Company	0	0	0	0	0	10	17	20	20	31
Hudson's Bay Company	0	4	8	9	9	9	9	10	10	17
Huebner Toledo Breweries Co.	0	0	0	0	0	1	6	8	11	16
E. V. Hull	0	0	0	0	0	0	2	4	11	11
Humble Oil & Refining Co.	0	0	0	0	0	0	0	0	13	52
Huntsville Coca Cola Bott. Co.	0	0	0	0	0	0	0	0	0	11
Illinois Pub. & Printing Co.	0	0	0	0	0	0	0	0	0	14
Imperial Oil Company, Ltd.	0	1	1	1	1	1	12	42	43	58
Indep'n't Brewing Co. of Pgh.	1	1	2	5	5	11	28	36	42	46
Independent Torpedo Co.	0	0	0	0	0	0	0	1	4	16
City of Indianapolis	0	0	0	1	1	2	2	2	6	12
J. S. Ivins' Son, Inc.	0	0	3	3	4	5	7	7	7	10
Johnson Oil Refining Co.	0	0	0	0	0	0	1	1	1	11
Jones Store Company	0	2	2	5	6	10	14	17	17	19
Kaufmann Dept. Store, Inc.	0	0	10	16	24	44	80	80	66	59
Kaufmann & Baer Company	0	0	0	1	40	45	51	59	60	60
Kennicott-Patterson Transf. Co.	0	0	0	0	0	0	0	1	3	10
C. D. Kenny Company	0	0	0	0	0	0	12	41	45	56
Kingan & Company	0	0	0	0	0	0	4	6	6	13
The Kirk Company	0	0	0	0	0	0	0	7	7	10
Theodor Kundtz Company	3	7	8	9	10	11	12	13	17	17
LaSalle & Koch Company	0	0	0	0	3	3	4	4	4	10
J. William Lee & Son	0	0	0	0	0	0	13	13	13	13
Fred T. Ley & Company	0	0	0	0	1	1	4	10	13	13
Leyte Land Transportation Co.	0	0	3	6	10	12	14	14	14	14
Liberty Baking Company	0	0	0	0	0	0	0	4	15	15
Lime-Cola Bottling Co. of S. C.	0	0	0	0	0	0	3	3	3	46
Lit Brothers, Inc.	0	0	0	0	0	0	17	26	27	28
Loose-Wiles Biscuit Company	0	0	0	0	0	2	2	2	11	21
Los Angeles Brewing Company	0	0	2	7	13	14	15	17	17	18
Los Angeles Creamery Co.	0	0	0	0	0	0	0	4	6	10
Los Angeles Ice & Cold Stor. Co.	0	0	0	0	0	0	5	10	10	11
H. C. Lytton & Sons (The Hub)	0	6	7	9	10	11	11	12	12	12
McCreery & Company	6	6	8	8	8	11	15	15	15	19
G. M. McKelvey Company	0	0	1	1	6	8	18	18	18	17
R. H. Macy & Company	0	0	0	0	0	0	15	15	15	15
Mandel Brothers	0	9	10	15	16	17	17	17	17	17
City of Manila	0	0	3	3	3	7	8	11	11	12
A. C. Marshall Company	0	0	0	0	0	0	0	15	15	18
State of Massachusetts	0	1	4	4	4	5	11	11	11	11
The May Company	0	0	0	4	11	15	26	26	27	40
Mesaba Transportation Co.	0	0	0	0	0	2	15	18	20	23
Metropolitan Coal Company	0	0	0	0	0	0	0	0	0	10
Michelin Tire Company	0	1	2	3	3	9	11	11	11	14
Mid-Kansas Oil & Gas Co.	0	0	0	0	0	0	0	0	4	11
Midwest Refining Company	0	0	0	0	0	0	0	2	6	12
Miller Rubber Company	0	0	1	2	2	2	5	5	5	11
H. W. Mollenauer & Brother	0	0	0	0	0	0	0	8	10	10

*Exclusive of subsidiary or affiliated companies individually listed.

Call

In Actual Service

	1910	1911	1912	1913	1914	1915	1916	1917	1918	To-day
K. E. & A. K. Morgan	0	0	0	0	1	1	6	7	8	13
The Moxie Company	0	2	4	5	5	5	5	5	7	12
A. I. Namm & Son	0	0	0	1	1	2	4	6	7	34
National Casket Company	0	0	2	10	14	15	19	21	24	26
National Refining Company	0	0	1	1	1	1	1	1	2	25
City of Newark	1	2	2	3	3	3	3	4	7	11
Province of New Brunswick	0	0	0	0	0	0	20	20	20	19
State of New Jersey	0	0	0	1	1	1	1	6	16	15
M. A. Newmark Company	0	0	0	0	0	0	0	8	8	10
State of New York	0	0	3	3	3	5	29	37	37	38
City of New York	0	1	7	11	12	13	13	13	13	13
N. Y. Bd. of Fire Underwriters	0	0	2	6	8	16	20	20	20	20
New York State Railways	0	0	0	0	0	1	5	10	10	10
Northern Ohio Trac. & Light Co.	0	0	0	0	0	0	4	5	5	10
Northern Texas Traction Co.	0	0	0	0	0	0	0	9	9	10
Province of Nova Scotia	0	0	0	0	0	0	0	0	10	11
Ohio Cities Gas Company	0	0	0	0	0	0	3	3	5	10
Ohio Oil Company	0	0	0	0	0	0	0	0	16	22
Omaha Taxicab Company	0	0	0	0	6	8	17	17	17	17
Onondaga County, N. Y.	0	0	0	0	1	3	5	10	16	16
Oppenheim, Collins & Company	0	0	0	0	20	21	27	27	30	38
M. O'Neil Company	0	0	0	0	1	1	3	3	3	14
Pacific Baking Company	0	0	0	0	0	0	1	5	5	15
Pacific Mills	0	0	3	4	4	7	12	14	17	19
Page & Shaw, Inc.	0	0	1	4	8	8	8	10	10	11
Frank Parmelee Company	0	0	0	9	9	18	28	28	28	28
Peninsula Rapid Transit Co.	0	0	0	0	0	7	8	15	19	28
State of Pennsylvania	0	0	0	0	1	2	5	15	15	16
Petroleum Heat & Power Co.	0	0	0	0	0	0	0	0	0	11
Philadelphia Electric Company	0	0	0	0	0	0	13	15	18	20
Pierce Oil Corporation	0	0	0	0	0	1	1	1	23	69
Pike's Peak Auto Highway Co.	0	0	0	0	0	12	15	15	16	16
Pilsener Brewing Company	0	0	0	1	2	3	5	7	7	11
City of Pittsburgh	0	2	9	14	14	15	15	15	15	15
Pittsburgh Gage & Supply Co.	0	0	0	0	0	2	4	6	9	12
H. & S. Pogue Company	0	0	0	0	0	0	2	3	12	12
Portland Sebago Ice Company	0	0	0	0	2	4	5	5	11	11
Powers Mercantile Company	0	0	0	0	2	4	7	8	8	13
Prairie Oil & Gas Company	0	0	0	0	0	0	0	2	26	54
Public Service Electric Co.	0	0	0	0	0	3	7	8	8	15
Quaker City Cab Company	0	0	0	0	0	0	75	100	100	125
Remar Company	0	0	0	0	0	0	0	0	11	13
Rieck-McJunkin Dairy Co.	0	0	0	0	0	0	2	16	23	24
Riverside Taxi Service Co.	0	0	0	0	5	15	15	15	15	15
Rochester Gas & Electric Corp.	0	0	0	0	0	0	0	0	3	13
Rocky Mt. Parks Transp. Co.	0	0	2	2	3	3	21	23	33	56
L. W. Rogers Company	0	0	0	0	0	0	0	0	0	12
Rome Coca Cola Bottling Co.	0	0	0	0	0	0	1	1	1	10
The Rosenbaum Company	1	1	2	11	12	33	39	43	40	37
Thomas J. Ryan	0	0	0	0	0	0	1	13	13	16
City of St. Louis	0	0	0	0	4	6	9	10	14	16
Saks & Company	0	0	0	0	10	10	10	10	10	10
Salt Lake Transportation Co.	0	0	0	0	0	0	0	4	15	15
San Bernardino M't'n Auto Line	0	1	3	4	6	6	9	14	15	15
City of San Francisco	0	0	0	1	1	1	1	3	10	14
San Francisco Drayage Co.	0	0	0	0	1	3	10	10	10	12
Sandersville Coca Cola Bott. Co.	0	0	0	1	2	4	5	5	6	10
Sanger Brothers	0	4	6	7	7	7	7	8	8	13
San Joaquin Light & Power Corp.	0	0	0	0	0	0	0	2	2	14
Savage-Schofield Company	0	0	1	4	5	5	5	6	7	10
Schmidt & Ziegler, Ltd.	0	0	0	0	0	0	0	10	10	10
Andrew Schoch Grocery Co.	0	0	0	0	0	6	6	11	11	11
Schulze Baking Company	1	1	9	15	17	22	23	26	31	35
Seiple & Wolf Construction Co.	0	0	0	1	2	2	10	10	10	10
Shaffer Oil & Refining Co.	0	0	0	0	0	0	0	0	1	43
Shell Co. of California	0	0	0	0	0	0	0	1	4	10
Franklin Simon & Company	0	0	0	3	6	10	14	14	17	18
Skinner Packing Company	0	0	0	0	0	0	0	0	0	11
W. & J. Sloane	13	14	15	15	15	17	21	23	23	28
Smith & Hicks, Inc.	0	0	0	0	0	0	3	13	13	13
Spear & Company	0	0	1	9	13	14	15	22	23	27
Otto Stahl, Inc.	0	0	0	0	0	0	0	0	5	13
*Standard Gas & Elec. Co.	0	1	2	2	2	3	5	11	17	14
Standard Oil Co. of California	1	3	4	6	7	26	67	97	111	188
Standard Oil Co. of Indiana	1	4	5	9	59	122	168	201	214	232
Standard Oil Co. of Kentucky	0	1	2	4	5	9	38	75	121	349
Standard Oil Co. of Louisiana	0	1	1	1	1	1	2	5	53	91
Standard Oil Co. of Nebraska	0	0	0	0	5	11	17	17	17	18
*Standard Oil Co. of New Jersey	0	0	1	1	1	1	3	30	65	65
Standard Oil Co. of New York	2	6	18	35	68	113	230	363	450	620
Standard Oil Co. of Ohio	0	1	1	1	10	17	28	36	42	78
Standard Sanitary Mfg. Co.	0	0	2	3	3	4	4	6	10	15
Stark-Tuscarawas Brewing Co.	0	0	0	1	1	2	7	12	12	12
Sterling & Welch Company	2	4	7	7	8	8	11	14	14	16
Sterling Products Company	0	0	0	3	6	8	8	8	9	14
Stern Brothers	0	0	8	18	18	19	21	22	22	25
Stewart & Company	1	1	2	4	6	7	8	8	8	12
Stewart Taxi Service Company	0	0	0	0	0	0	18	29	43	42
Stone & Webster Interests	0	1	1	1	2	2	8	15	22	31
Strawbridge & Clothier	0	0	0	2	4	4	9	15	15	15
Stroehmann's Vienna Bakery	0	0	0	2	2	2	10	10	11	14
Sun Company	0	0	0	0	0	0	0	0	1	10
*Swift & Company	0	0	0	2	2	10	101	109	127	164
Swift Canadian Company	0	0	0	1	2	2	2	6	7	11
Tacoma Bottling Works	0	0	0	0	0	0	0	6	10	15
Taggert Baking Company	0	0	0	0	0	0	0	0	0	10
The Taxi Company	0	0	0	0	2	4	13	13	14	14
Wm. Taylor Son & Company	0	0	0	0	0	0	2	4	4	24
Telling-Belle Vernon Company	0	3	4	4	9	11	11	13	20	42
Terminal Taxicab Company	0	0	20	36	61	61	61	82	82	99
The Texas Company	0	0	0	0	0	9	11	11	11	64
Texas Pacific Coal & Oil Co.	0	0	0	0	0	0	0	0	0	25
Thompson & Smith	0	0	3	7	7	9	9	10	10	13
Tide Water Oil Company	0	0	0	0	0	0	0	3	4	27
Twin City Motor Bus Company	0	0	0	0	0	0	0	0	19	19
Union Carbide & Carbon Co. Int's	1	1	1	2	3	6	16	18	21	20
Union Oil Co. of California	0	0	0	1	10	22	43	156	216	393
Union Gas & Electric Co.	0	0	0	0	0	0	0	1	1	19
Union Transfer Company	0	0	0	0	0	0	1	11	12	12
Union Wholesale Lumber Co.	0	0	0	0	0	0	0	6	6	11
United Gas Improvem't Co. Int's	0	0	0	2	8	15	41	64	64	65
United Shoe Machinery Corp.	0	0	0	0	0	0	0	0	1	10
United States Bakery	0	0	0	0	1	2	2	11	14	20
U. S. Trucking Corporation	0	0	0	0	0	0	0	14	20	51
United States Rubber Co.	0	0	0	1	2	5	5	9	14	16
U. S. Post Office Department	0	0	0	21	27	104	132	298	445	463
U. S. Steel Corporation Interests	0	0	1	1	2	3	5	12	17	17
Updike Lumber & Coal Co.	0	0	0	0	0	0	0	3	5	12
Van Dyke Taxicab Company	0	0	0	0	0	0	0	0	10	10
E. H. Vare	0	0	0	0	0	0	0	5	11	11
F. G. Vogt & Sons, Inc.	0	0	0	1	2	3	5	12	14	14
John Wanamaker	0	0	0	0	0	6	27	37	37	63
Ward Baking Company	0	0	0	0	0	12	53	76	76	78
Webster Transportation Co.	0	0	0	0	0	0	0	0	0	14
Raphael Weill & Company	0	0	0	0	0	10	10	12	12	20
Western Electric Company	0	0	2	4	5	5	9	15	19	24
Western Meat Company	0	0	0	0	0	0	2	11	12	27
Western Motor Transport Co.	0	0	0	0	1	1	3	6	6	22
Westinghouse, Church, Kerr & Co.	0	0	0	0	0	0	0	6	30	30
J. G. White & Co., Inc., Interests	0	1	1	1	1	1	4	16	19	12
R. H. White Company	0	0	0	0	0	1	4	13	13	13
White Bus Line, Inc.	0	0	0	0	0	0	5	12	16	28
White Star Auto Line	0	0	0	0	0	3	6	9	9	11
White Taxi Company	0	0	0	0	0	0	24	24	25	43
White Taxicab Company	0	0	0	0	0	0	2	11	11	11
White Transit Company, Inc.	0	1	1	2	6	9	19	29	31	36
Wilson & Company	0	0	0	0	0	0	1	1	2	22
Wm. Winkler (Steele-Wedeles)	0	0	0	0	0	0	0	0	0	10
Woodward & Lothrop	0	1	1	3	3	4	7	13	14	13
Geo. Worthington Company	0	0	1	2	2	2	4	8	10	15
Yellowstone Park Transp. Co.	0	0	0	0	0	0	106	112	112	135
Yosemite National Park Co.	0	0	0	1	7	7	25	27	24	25
Zettelmeyer Coal Company	0	0	1	2	2	3	4	5	10	10
Zumstein Taxicab Company	0	0	0	2	2	6	10	20	25	25
	56	205	526	1073	1798	2711	5270	7637	9413	12674

THE WHITE COMPANY

Cleveland

*Exclusive of subsidiary or affiliated companies individually listed.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Aeronautics

FOLDING LANDING GEAR FOR AIRPLANES.—M. H. Megaffin, Edgewood, Iowa. An object of the invention is to provide a folding landing gear which may be folded when the machine is in the air, but which may be released at will, to assume a position for landing. A further object is to provide means for positively locking the landing gear in its folded position and also in its extended position.

Pertaining to Apparel

ATTACHMENT FOR COMBINING COLLARS AND TIES.—J. R. Elizondo, Box 970, City Hall Station, New York, N. Y. Among the objects of the invention is to provide a device for combining the collar and the necktie that will allow the application of the combined collar and tie to the shirt at the same time, that will economize not only in the tie material but in the durability of the tie, and that will provide means for supporting any standard or approved type or design of necktie.

Electrical Devices

OSCILLATION GENERATOR FOR WIRELESS SYSTEMS.—M. Berel, and L. Funke, 885 Westchester Ave., Bronx, N. Y. The invention has for its general object to provide a high frequency polarity reversing switch in combination with a source of electro-motive force, direct or alternating, and a condenser whereby the terminals of the condenser are reversed with respect to the terminals of the source of electro-motive force in rapid succession to produce continuous oscillations of radio frequency for radio purposes.

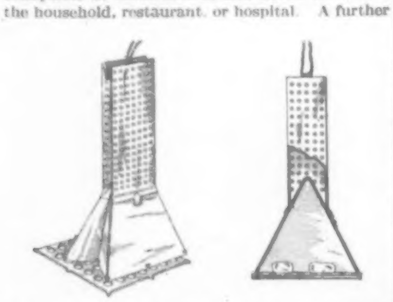
Of General Interest

DOOR STOP.—J. T. Little, Box 253, Gainesville, Fla. An important object of this invention is to provide a device of the above mentioned character, adapted to be secured to a door, and having an element to engage with the floor, for holding the door open at desired positions, such device being applied to the door by means of a recess in the outer edge. The device is simple in construction and easy to operate.

HAT AND COAT RACK.—B. Brager, 84 Fifth Ave., New York, N. Y. The invention has particular reference to a hat and coat rack comprising a bracket, an arm connected and extending outward therefrom, the arm being made of rod metal and having its outer end provided with a pair of vertical kerfs, a mirror having on its back an open bottomed clip with a pair of parallel flanges along its back portion slidably fitted in the kerfs, the movement of the mirror and clip downward being limited.

ADJUSTABLE BRACKET HOLDER.—L. Schwarz, 31 Stevens Ave., Jersey City, N. J. The invention aims to provide a bracket for both curtain poles and window shades. A further object is to provide a device of this nature which shall be adjustable in a horizontal plane, so that should a pole of slightly greater length, or a shade of greater width be applied no necessity would arise of removing the bracket, but the same might simply be adjusted in a longitudinal direction to accommodate the new fixtures.

FLYTRAP.—P. Curran, Box 85, Chicago Heights, Ill. The chief object of the invention is to provide a fly trap which will be effective and sanitary in operation, and pleasing in appearance, collapsible in construction, and suited for use in the household, restaurant, or hospital. A further

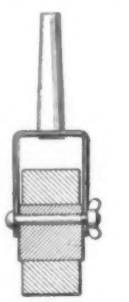


A FRONT VIEW PARTLY IN SECTION, AND PERSPECTIVE VIEW PARTLY FOLDED

object is to provide a device constructed of paper, or similar material, capable of being folded for convenience in storage, and also for the purpose of killing the flies, if so desired. The device may be produced at small cost, paper, tin, aluminum or other light metal being employed.

Hardware and Tools

ADJUSTABLE CASTER.—C. W. Ostrander, 147 Pratt St., Winsted, Conn. The invention has for an object to provide a construction in which the usual caster effect is secured and at the same time means for producing a variation of

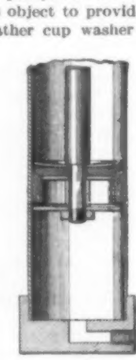


A TRANSVERSE SECTIONAL VIEW OF THE INVENTION

height of the caster. A more specific object is to provide a caster with a bearing member capable of adjustment for raising and lowering the wheel of the caster in order to level up an object on which the caster is placed.

Machines and Mechanical Devices

PUMP PISTON.—B. F. Moss, Box 3161 Lowell, Bisbee, Ariz. This invention relates particularly to pumps of the reciprocatory type and has for its object to provide a pump piston including a leather cup washer within which is



A SECTIONAL VIEW OF THE LOWER PORTION OF THE PUMP BARREL

disposed a split spring ring which bears resiliently outwardly causing the washer to engage the periphery of the pump barrel to form a leak-proof contact, and whereby the wear of the cup washer will be automatically taken up.

Pertaining to Vehicles

SHOCK ABSORBER FOR AUTOMOBILES.—S. E. White, Marion, Ohio. An object of the invention is to provide a device which is adapted to take up both primary and secondary shocks. A further object is to provide a device having adjustable means to regulate the tension of the yielding elements, whereby the device is adapted for use upon automobiles of different sizes or weights.

Piercing the Catskills for Water

(Continued from page 538)

harmful consequences of an unexpected detonation of dynamite anywhere within the neighborhood of a heading. The pneumatic rock drill is being used to make all of the holes for the blasting charges; and the passage through the excavated rock is required to be large enough to insure a clearance that will permit an innermost shaft wall of at least 3 inches thick of solid concrete. From this shell back to the interstices of the blasted rock, additional concrete and grouting will bring about a perfect union between the shell and the enveloping ledge.

The contractor is expected to produce the smoothest practicable finish to the surface of all concrete wherever it forms part of the waterway. In order to obtain this result, the model or mold, especially where it is used repeatedly, is of metal construction; but in cases of infrequent employment, agreeably to modifications of tunnel shape, the molds are of wood covered with light galvanized sheet steel. In this way, uniformity of the internal modeling of the tunnel will be secured throughout long stretches.

While the depth at which the tunnel is being driven is such that there is little likelihood of any water courses of large capacity being encountered, still the "head" of small flows may be found sufficient to cause considerable trouble unless they are promptly sealed or diverted. Where the nature of the stream is such that nothing short of effectually blocking its path will do, this will be achieved by forming the tunnel shell for a suitable distance, bulkheading each end, and then forcing grout in under pressure outside the shell until the cement mixture solidifies and chokes the subterranean spring, etc. Where otherwise possible, however, pipe drains will be laid beneath the tunnel, thus permitting the seepage or flow to follow substantially its natural path—the piping, of course, being imbedded in concrete. In earlier tunneling operations, the engineers of the Board of Water Supply have skilfully met and disposed of large quantities of invading water.

At the southern end of the tunnel, just before Esopus Creek is reached, the structure will be of the cut-and-cover type, built in an open trench. A portion of this tunnel will be composed of reinforced concrete. Further, the several sections of the cut-and-cover conduit will be of successive 15-foot lengths bound together by steel-plate joints, thus providing for expansion and contraction of the structure longitudinally. At the admission and discharge ends of the tunnel there will be installed great Venturi meters, provided with bronze piezometer castings, each 8 feet 8 inches in diameter, which will make it possible to measure the volume of water passing.

Under normal conditions, the tunnel will carry daily under the Shandaken Mountains of the Catskill range a matter of 250,000,000 gallons, but, when the flow of the Schoharie watershed permits, this may be amplified to 600,000,000 gallons every twenty-four hours. Investigations made since the utilization of the Schoharie region was first proposed have revealed that the run-off is apt to be of a much larger volume than originally contemplated. Therefore, the Shandaken tunnel will be the means of adding generously to the water otherwise reaching the Ashokan reservoir, and to that extent potentially safeguarding Greater New York from scarcity. However, with the steady growth of the Metropolis and the annual increase of the vast army of daily transients, it is certain that it will be necessary in the future to bring into the water supply system the yet untouched area contiguous to Catskill Creek.

As an engineering task, the Shandaken tunnel is of major proportions, and this can best be realized by the layman if he be reminded that the famous Simplon tunnel, piercing the Alps, is but 12½ miles between portals.

Making a River Pump Its Water Uphill

(Continued from page 539)

eighteen feet above the surface of the stream.

The device consists of two parallel sweeps, each fourteen feet in length. On the downstream end are sixteen vertical paddles arranged in two parallel rows within a suitable framework. The paddles are about fifteen inches apart, and each measures fourteen by twenty inches in size. The paddles are pivoted on vertical pins, the pins being placed a little off center of the paddles. The arrangement is such that the paddles have an angular movement of a little less than forty-five degrees. Each paddle is 1¼ inches in thickness; they are built of galvanized iron and are hollow in order to secure buoyancy. From the top and bottom edges of each paddle project flanges 1¼ inches in depth. The whole apparatus being attached to a cable anchored in the middle of the stream, the pressure of the flowing water against the sides of the deflected planes swings the sweep across the river, and after a certain distance of travel an automatically operated spring throws the planes in the opposite direction and the sweep reverses itself, traveling back across the current. Thus it moves back and forth with the regularity of a pendulum. By means of cable attachments the movement of the machine is transferred to a reciprocating beam, which is connected at its ends to the pistons of a pump on shore. The reciprocating beam works on a pivot which is firmly anchored to the ground.

To Offset the High Cost of Ice

(Continued from page 539)

which does not refrigerate during the generating period and the continuous, which gives constant refrigeration.

In the intermittent method the principal parts are a generator, a condenser, a receiver and refrigerating coils. The generator contains aqua ammonia. A gas burner is located below it. The gas burner is lighted and the heat from the gas burner converts the aqua ammonia into ammonia gas which passes into the condenser where it becomes liquid. The liquid then passes into the receiver. As soon as the receiver contains sufficient ammonia the heat is turned off and the solution remaining in the generator is cooled. The ammonia valve leading from the receiver is then opened and refrigeration takes place. This is due to the fact that when liquid ammonia passes through a small orifice from a higher pressure to a lower pressure it becomes a gas and a great drop in temperature takes place.

After the ammonia has done its work it passes back to the generator which temporarily acts as an absorber; that is, the solution remaining in the generator absorbs the ammonia gas. As soon as all of the ammonia is absorbed into the generator the entire process is repeated. The same ammonia is used over and over again. The continuous method is the same as the intermittent with the exception that two generators are used instead of one. This makes it possible for one generator to absorb the used gases while the other generates.

A Merlin of Today

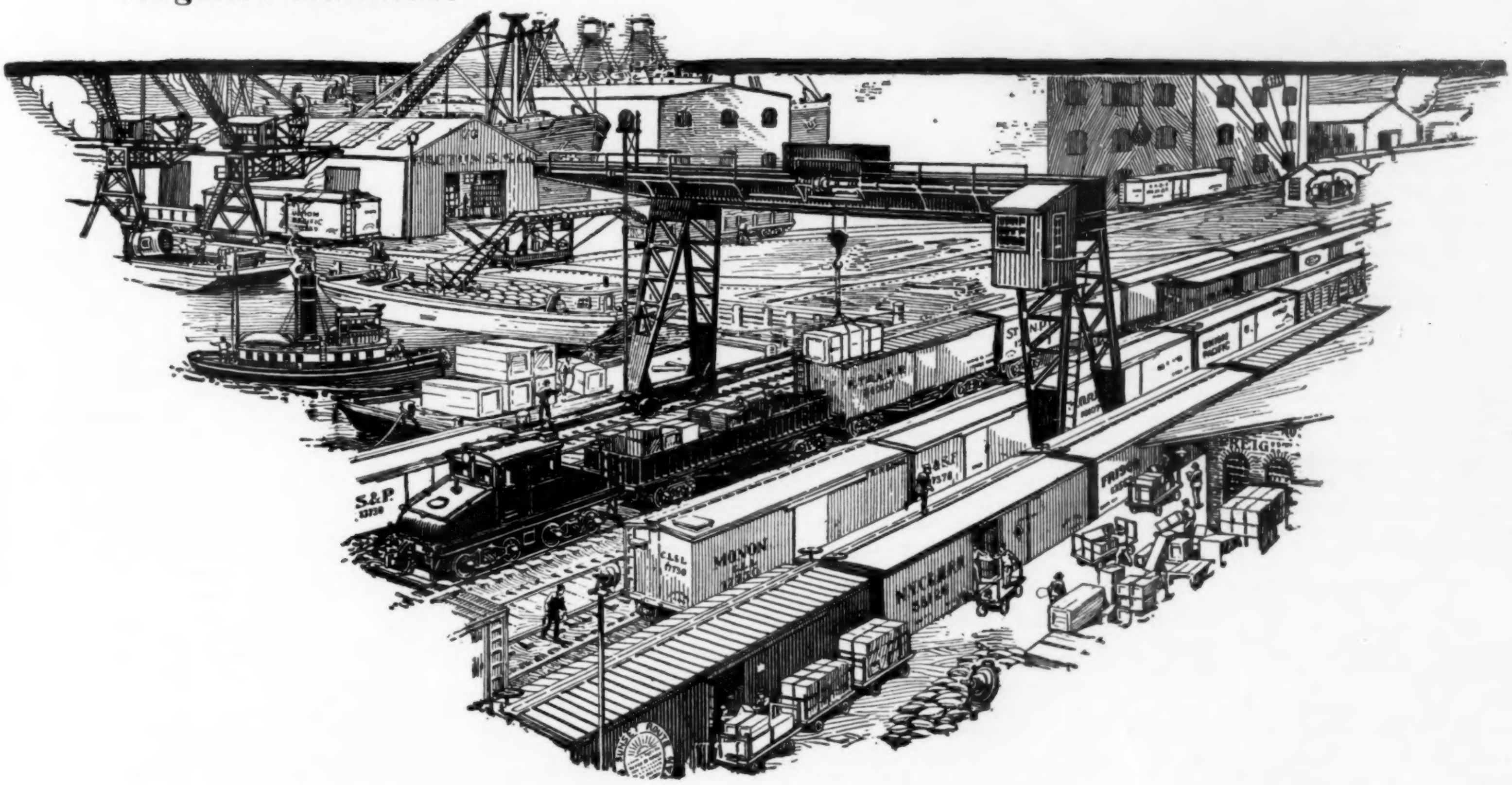
(Continued from page 540)

the figure 1, followed by fifty ciphers. Ten to the fiftieth power, in other words. Write this number down and take a look at it. It is inconceivable by a finite mind—any number which can be divided or multiplied by a billion without making any different impression on the mind is inconceivable.

A few moments ago reference was

(Continued on page 554)

Intensive application of electric machinery in and about terminal warehouses is the principal factor contributing to the speedy reduction of congested conditions



Electric Power Wiping Out the High Spots in Transportation Costs

IT is of vital importance that freight handling costs and congestions at terminals be reduced. The only way this can be efficiently accomplished is through the increased use of mechanical methods and quicker means of transportation around terminals.

Electricity as applied to these handling and transporting devices has thoroughly proved its superior worth in operating cranes, winches, stacking machines and storage battery tractors.

Tractors in one terminal enabled 100 men to load 40 cars per day, where formerly 16 cars were loaded. An electrically operated stacker can handle 50 tons of bags per hour, and raises the height of the pile from about one, or two tiers, to 15 feet from the floor.

Other electrically driven mechanical devices are operating with the same efficiency. Portable conveyors, in one case, not only released 15 men for other work, but accomplished the same unloading in one-third the time required formerly.

The numerous applications of electricity to operating locomotives, cranes, winches and stacking machines all have the same quick clearance effect on congested conditions in ports, freight depots and industrial plants.

When you submit your material handling problems to a manufacturer of this equipment, *specify G-E Motors and Electric Control.* This insures you specialized service of General Electric Company engineers co-operating with the manufacturer in the satisfactory achievement of your individual requirements.

43-508

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A Merlin of Today

(Continued from page 552)

made to the audion being the physicist's microscope for magnification of minute impulses. The greatest magnification which the ordinary microscope can accomplish is approximately 5,000 diameters. . . . The ultramicroscope does much better but the ultramicroscope does not show objects, merely the interruption to light rays by objects too small in themselves to be seen. Compare a magnification of 5,000 diameters—and call it 2,500,000 times if you like—with a magnification of current impulse by 10 raised to the 50th power.

The possibilities of the application of such a device are not even now realized. We shall hear sounds in the body we have never heard before—the blood in the smallest veins, the movements of the various organs. Heart murmurs will become heart shouts and pulmonary sounds will become pulmonary shrieks if desired. We shall hear physical sounds we have never known exisfed before. It has even been predicted, poetically enough, and yet with a sound basis of possibility, that some day we may hear the collision of the individual atoms.

Transcontinental telephony is wonderful enough. But what of transoceanic wireless telephony? When the human voice can be heard from Arlington to Honolulu, half way round the world, when New Brunswick talks with Brest, across the Atlantic, can there be any doubt that the day of "wireless" in the ordinary sense has already come and gone? True, the telephone has not superseded the telegraph upon land, but if we will carefully analyze why, we find that first, telephone messages over long distance cost much more than telegrams, and second, they are not to be had as quickly as telegrams, at least on the part of the sender. And if we ask why these conditions obtain, we receive the all sufficinet answer that if we wish to talk from New York to Chicago we must hire the exclusive use of two copper wires stretching between those cities—a highly expensive installation to make and keep in repair and not to be rented for a few cents. Now comes the audion to supplement the very newest radio wonder, "wired wireless," in which a single wire, guiding a wireless current, will carry as many telephone messages as can be placed upon it with currents of different frequencies, and the audion amplifiers will untangle the web of voice currents and receive them clearly at the other end. When telephone calls of a thousand miles distance are less expensive than telegrams, when the present wait for a line is reduced to one-tenth the present delay, it will be strange indeed if the ordinary telegram does not struggle for its life against the easier and more satisfactory voice.

But the radio 'phone should be no more expensive than the radio Morse message. Ships at sea now listen to a thousand other ships and stations signaling, each with its different wave length, each with dots and dashes. Can any one doubt that the future means that space will be filled with voices, instead of dots, and that we will literally talk across the water, instead of signal, as at present? Not with the performances of the audion before our eyes can we so doubt.

The audion has worked so many revolutions that we rather expect it to work a few more. Nor does it appear that we are to be disappointed. Already the huge antennæ of the great station have been rendered unnecessary for receiving purposes. More than one amateur hooks his "lead in" to his bed spring and receives quite well the feeble currents so caught—because he has audion amplifiers. During the war receiving apparatus which could be carried on a motorcycle was used by the Allies and used in a dugout—"antennae" included. Dr. De Forest does not say that aerials are doomed, but he does believe that in place of erecting them hundreds of feet in the air, we are rapidly coming to the point where we will bury them deep in the ground.

We are by no means at the end of even the beginning of the story of the audion. For it has possibilities and potentialities which are as yet hardly more than formulated. For instance, the audion can be made to operate as a generator—a generator without moving parts, requiring no oil, no attention, no prime mover, and yet capable of producing high frequency alternating currents of from one to ten millions of oscillations per second.

What the future of the audion may be, no one, not even Dr. De Forest himself, knows or will try to say.

We do not know what an audion cannot do, because we haven't had it long enough to find out. We do know that with the apparent possibility of magnification of feeble electric impulses to an indefinite amount a new world of physics is open to us, and it seems highly probable, though Dr. De Forest would hardly wish to sponsor the statement, that many, if not all, of the investigations into the ultimate nature of both matter and force—upon which may depend in a large measure the future of power and so the future of civilization—will depend on the audion and its modifications for their most reliable tool.

Dr. De Forest is not through with audion, by any means. While his factory is engaged in the production of radio apparatus as well as of audions for commercial use (during the war exclusively for War Department use) he is personally engaged in improvements in the device and in its commercial application.

But meanwhile he is personally engaged in audion experiments to better and increase its ability to work wonders. To those who remember the first little bulbs, the half-kilo bulbs now being put forth and the prospective kilowatt bulbs will seem revolutionary. Dr. De Forest, so accustomed to the wonder worker which is his child, invites his visitor's attention to their workmanship. But the visitor is apt to be too much awed to see merely a mass of glass and wire; he visualizes not the clever craftsmanship, but the genuineness of the contribution to both pure and applied science. Trying to realize what the audion has meant and a little of what it will mean, he cannot but wonder if the future will not rate the little marvel-worker and its inventor well towards the front of the list of those who are the pioneers of science.

Making Bad Land Good

(Continued from page 542)

may be classed as dry farming, even in the humid regions, where there are copious rainfalls.

Now there are marked differences in what we call arid regions, but the differences referred to in the present case are of a climatic character. The Rocky Mountain plains belt the great rolling prairies of Colorado, Wyoming, New Mexico, etc., and their contiguous environs, are far from being absolutely arid. There is a certain amount of precipitation, year by year, and throughout the year. In fact, the average person would not call this an arid climate at all, and it may not be so in the stricter sense of the word. Yet it makes farming without irrigation a serious problem, for these reasons: The free run off of all precipitation, coupled with rapid evaporation. The surface of the native sod is a good deal of a crust, and only the hollows catch much water that is held in abeyance. But the really patent agencies of a dry climate are the light, dry air, and the bright and abundant sunshine. In Colorado you may safely gamble on three hundred sunshiny days out of every three hundred and sixty-five.

So slight a respect does the irrigation farmer of Colorado have for the normal precipitation as applied by Nature

(Continued on page 556)

Making Bad Land Good

(*Continued from page 554*)

to his thirsty acres, that even during the heaviest rainfall he dons slicker, leg-long rubber boots, and an oilcloth hat with a shed roof to it, and sallies forth into his cultivated fields, spade in hand, opening up his headgate and proceeding to irrigate with every possible cubic inch of water that the law and the ditch superintendent will allow him. The man who would farm without irrigation here must get right down to the theory and practice of intensive farming; for dry farming, carried to its final analysis, is simply intensive farming, deep, thorough plowing, cross plowing, harrowing, cultivating and then more cultivating to be repeated all through the growing season.

This deep and thorough mellowing of the soil permits, not only the full reception and retention of all current rainfall, but also the rise of hidden supplies of moisture lying in the sub-stratum of the land, up to the root masses of the growing crops.

Now the aridity of California is far different from the aridity of the Rocky Mountain plains regions, being seasonal rather than annual. There is an absolutely dry season and an absolutely wet season. The first extends from about the first of May to anywhere between August 20th and December 20th.

During the dry season the whole country becomes a russet-brown, save where there are trees, orchards, vineyards or growing crops. All up and down the coast the drouth conditions are somewhat ameliorated by heavy sea fogs which drift in from the Pacific on the wings of the Japanese trade winds, which blow daily from the west, from the first of June until the first of September.

The ground dries, then bakes and finally cracks open, showing, before the season is over, deep clefts that widen as the season advances.

Then come the rains, at first borne upon the wings of a balmy south wind, that blows up from equatorial latitudes, like a ministering spirit. As the season advances the rainfall increases, and soon all the plains and hills, hitherto of brown and amber garb, begin to put on a dress of delicate green, so that by mid-winter the whole face of nature is lush and green with the fresh wild grasses, standing half-knee high in the pastures, on the hillsides, and in all the glens of the foothills and the mountains.

Yet within the limits of California's thousand miles of longitude there are different degrees of rainfall. The total rainfall for the year 1917 in the Imperial Valley, in the extreme southern part of the state, was 1.84 inches; for the year 1918 it was 1.94 inches. In Humboldt County, in the extreme northern part of the state, the total annual rainfall for the year 1917 was 28.73 inches, for the year 1918 it was 27.94 inches.

Thus we see that California is more deeply interested in moisture conservation than is Colorado, and contiguous sections. Its rainfall comes in the late fall, winter and early spring. Then it ceases and there follow months of absolutely rainless days. Consequently special effort must be put forth to save for agricultural purposes the rainfall of the rainy season, against the withering effects of the rainless season, which season happens to be that during which the great bulk of the products of dry farming must be matured.

As far as dry farming is concerned—and dry farming must necessarily constitute the bulk of the farming in the state—the only practicable method of moisture conservation is the proper preparation of the soil both to receive and to retain the maximum amount of rainfall. This implies early and deep plowing, subsoiling and the employment of all known means of breaking up, lightening and pulverizing the soil.

Now let us take a glance at the swamp

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land proposition. We have already stated the aggregate acreage of swamp lands in the United States. These are lands that are largely submerged, in their natural state, and in order to be reclaimed must be surface-drained by means of either the excavation of large drainage canals or the building of dikes and levees, and the pumping dry of the enclosed areas. Samples of such work are to be seen in the lowlands of the Mississippi valley, and the delta lands of the Sacramento and San Joacquin valleys in California.

But there are other classes of wet lands that have not been included in the category of swamp lands. These consist of the swales, bogs, river bottoms, salt marshes and seeped lands of our farm communities. In all irrigated sections which have come under my observation, there develop in course of time seeped sections. Let me give an instance:

The seepage of the run-off or surplus water from the irrigated lands above all goes in search of the river level; the bottom lands become too wet; then the alkali begins to rise on the crest of the underflow, and there will be some ranches that after a while become white with alkali erosion and entirely spoiled for any kind of a crop. Many lowland ranchers have brought suit against the farmers and irrigation companies and readily recover heavy damages. The only remedy for this evil of seepage was found to be the drainage of the seeped lands.

Now we have set the stage for the Drama of Reclamation! Let us ring up the curtain and call on the actors. The two leading characters, the star performers in the play, are the Man and the Machine. The first has become imbued with new ideals and animated by higher aspirations. Moreover, he has become possessed of a powerful ally—the Machine.

With the farm tractor pulling with titanic strength and power the tractor-chisel, he attacks the stubborn prairie sod of Colorado in common with the sun-baked adobe beds of California and rips them up, out of hand, and then puts the finishing touches on the job by the use of the subsoil plow, the giant cultivator, the clod crusher and a long line of other modern farm implements. Or, if he be a wet farmer instead of a dry farmer, and under-drainage be his game, we find him equally well armed and equipped. The motive power, of course, is the inevitable farm tractor—a 40, a 75 or a 90 horse-power machine, according to the difficulties he must encounter.

But how about the art and science of under-draining? We know something about the job of under-draining up to date—the slowly excavated trench, the clogged plow, the disgusted man with the spade who dabbles all day long in a narrow, water- and mud-filled trench, clad in hip-boots; the laborious task of laying drain pipe, length by length, or the dumping of cobblestones into the bottom of the trench, and finally the filling in of the trench with that same mud that has been so painfully elevated from the depths below. We must also count the labor cost and the cost of tile pipe or rock work.

But all that seems to pass like the dark figments of a bad dream. Modern inventive genius has solved the problem of land under-drainage; at least, it has gone far along that path toward human emancipation. It has invented and fabricated a very simple machine that turns the trick.

It is called the drainage or gopher plow. It is the counterpart of a huge human arm crooked a little more than at right angles at the elbow. Only this arm is made of the strongest crucible steel instead of weak flesh and blood. It is mounted on low wheels, and is supplied with wheel lifts, etc. One end is joined to the plow's steel frame or bed. The other end is armed with a sharp steel blade for penetrating the subsoil.

When lowered into the earth, and pulled by a powerful farm tractor the chisel slices the earth in twain, and deep down opens a way for the conical steel follower that is also attached to this lower end of the arm. This follower, moving slowly along the opening made by the blade in front, presses the loosened earth outward in all directions and leaves behind a neatly excavated and cemented tunnel, or gopher hole, which serves the important purpose of a continuous underdrain.

So now we may lay an ideal underdrain at any desired depth within reason, and at the rate of a couple of miles an hour, leaving behind but a slight scar on the surface of the ground.

Our Share of The German Fleet

(*Continued from page 543*)

the limit and various compartments were flooded by the inrushing water. She was kept afloat by her pumps and ultimately reached Wilhelmshaven.

Next in order of size and fighting value comes the light cruiser "Frankfurt." The details are as follows: Length, 465 feet; beam, 45.5 feet; draft, 7 feet. Normally loaded she displaces about 5,100 tons, though it is said at full load she displaces well over 6,200 tons. Her main armament consists of 8 50-caliber 5.9-inch guns. The torpedo battery consists of two submerged 19.7-inch torpedo tubes. For a cruiser of 5,000 tons the "Frankfurt" is heavily armored. The belt is 5.9 inches thick amidships, tapering to 3.9 inches at the bows and 3 inches at the stern. In addition to this she has a protective deck 1.5 inches thick and some light internal armor. The designed speed is 28.5 knots per hour. The maximum fuel carried is 1,500 tons of coal and oil.

To the "Frankfurt" lies the honor of being the first ship to sight the British in the battle of Jutland. Later she was one of the German ships beached by the British guard boats during the attempt of the German crews at Scapa Flow to sink the vessels which were intrusted to their care. The machinery is ruined as the ship settled deep into the mud and her bottom filled with water from the open cocks. It will be necessary to tow her to this country and the transport "Hancock" has been detailed to that duty.

The "Frankfurt" is slated to be studied and then broken up, but in consideration of the fact that we have only three poor excuses for fast cruisers in our naval service, would it not be good policy to refit this thoroughly modern German scout into a good American?

The destroyers allotted to us are the G102, S132, and the V43. The G102 is the largest and most important vessel of the trio. She was built at the Krupp Germania works in 1911-1914 for the Argentinian government as the "Santa Fe," but was taken over for the German Navy on the commencement of hostilities. The length is 312¾ feet, the beam about 30 feet and the normal draft about 9 feet, and the displacement 1,250 tons. The armament was 4 4.1-inch and 2 machine guns with a small high angle gun for defense against aircraft. The torpedo tubes are six in number and of the 19.7-inch type. The vessel's machinery consists of turbines and 5 double ended boilers. The shaft horse-power is 24,000 for a speed of 32 knots. The ship is an oil burner and carries 345 tons of fuel oil, giving her quite a large radius of action.

The next destroyer, in the matter of size, is the S132. She was built at the Schichau works at Danzig during 1917 or 1918. Of about 800 tons displacement her dimensions are: Length, 270 feet; beam, 27 feet and normal draft, 9 feet. The armament consists of 3 4.1-inch, 2 machine and one small anti-aircraft guns. She has 4 or 6 torpedo tubes. The speed is 35 knots and the screws are driven by turbines. Steam is generated in oil-fired boilers. Very little is known of this class of destroyers and her coming is awaited with great interest.

The smallest German destroyer given to us is the V43. This boat was built by the Vulkan company and launched during 1915. She is of 710 tons displacement and her dimensions: Length, 262 feet; beam, 26 feet and normal draft about 9 feet. The armament consists of 3 3.4-inch, 22-pounder and 2 machine guns and 2 twin and 2 single 19.7-inch torpedo tubes. The machinery consists of turbines and oil-fired boilers. The shaft horse-power is 23,000 for 34 knots and 300 tons of fuel oil is carried. The complement is 100.

The Architecture of the Atom

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helium; the remaining eight electrons are disposed about them as shown. This atom is also symmetrical with respect to the equatorial plane. All spaces allotted to electrons are occupied. A drawing of the argon atom in accordance with the postulates will show a similar symmetry. These substances have attained an electronic state of balance and stability. All these gases are inert and their inertness is explained in this way. Only helium, neon, argon, krypton, xenon and niton have their outer shells thus completely balanced and occupied with electrons. Their inertness is due to this structure which is not possessed by the atoms of other elements.

If we draw Fig. 4 without the reference sphere and plane (also omitting the nucleus and its two attendant electrons) the outer layer of electrons of the neon atom appear as in Fig. 5. When lines are drawn between the electrons we see that they are disposed at the corners of a cube. This outer layer of eight electrons is called "an octet." Such an arrangement seems to be an ideal one. It is believed that all electrons endeavor to form octets. The disposition to form octets is one of the most important parts of this theory. We shall see in our next paper how this tendency can be used to explain the structure of chemical compounds.

Now we shall deal with elements only and illustrate how some molecules may be represented according to the electronic conception. Fig. 6 shows the appearance of the fluorine atom. The nucleus and its electrons are not represented for the sake of simplicity; we shall do this hereafter so that the diagrams will not be confusing. It is assumed that when two atoms unite to form a molecule they endeavor to form complete octets; to accomplish this ideal arrangement atoms will share electrons with each other but always in *pairs*. In the case of fluorine there are 7 available electrons in an atom and 14 electrons in two atoms; they combine to form a fluorine molecule, F_2, as shown in Fig. 7, two octets having one pair of electrons in common.

This arrangement of octets—pairs of electrons which are shared between them—is of prime importance and we shall refer to it again. Note also that it is possible for octets to share more than one pair of electrons. In similar fashion the oxygen molecule, O_2 and the triatomic molecule of ozone, O_3, may be represented.

The structure of the nitrogen molecule, N_2, is less easy of graphical representation. We shall not here discuss the considerations which lead to the more complex structure assumed for it. The unusual character of nitrogen and the chemical behavior of nitrogen compounds can be explained by the rare form of this molecular aggregate.

In a later issue this theory will be extended so as to include its application to compounds. It is interesting to note that by simple mathematical treatment of the octet conception and the habit of sharing pairs of electrons, it is possible to predict whether a compound can exist or not. Thus time and effort in research may be conserved.

NEW BOOKS, Etc.

EFFECTIVE HOUSE ORGANS. By Robert E. Ramsay. New York and London: D. Appleton and Company, 1920. 8vo.; 361 pp.; illustrated.

A house organ should be regarded as a part of the general plan of advertising, and as such the author deals with it. The "brass tack experiences" of the best men in the field have gone to the making of this book, which lays down the underlying principles of editing and publishing house organs of all descriptions, and shows the actual application of these principles. It goes into make-up and mechanical details, demonstrates how manufacturers, wholesalers, retailers, banks and many others put out successful papers, and deals with costs and results.

SAFETY FUNDAMENTALS. New York: Safety Institute of America, 1920. 8vo.; 228 pp.; illustrated.

This collection of papers, at once concise and comprehensive, benefits the employee—and hence the employer—by giving the inspector a broader outlook and a surer grasp of essentials. Here he may learn something of the body, and the relations of health to labor stability and accident frequency; the treatment of injuries; the most approved protective clothing for men and women; simple, efficient machine guards; heating, ventilation, and illumination; and safety education and shop organization. The lectures on which the work is based were given before inspectors by the Safety Institute of America. Many of the slides and films then shown are reproduced in illustration of the points made by the lecturers, who are without exception men of the highest standing in the subjects they discuss so illuminatingly.

WARNE'S BOOK OF CHARTS. Southern Building, Washington, D. C.: Frank J. Warne. Folio; illustrated.

Graphic charts are the shorthand of statistics, only in this case the shorthand is easier, not harder, to read than the corresponding longhand. It is "picture writing" at its best. In these hundred specimens of bar, curve, and circle diagrams will be found displayed all the rules and principles of chartography, with suggestions of import to industrial statisticians. Transportation, operation, production and revenues are all interpreted in the most approved ways, making up a folio of graphs that the student will find extremely useful.

THE SCIENCE OF EVERYDAY LIFE. By Edgar F. Van Buskirk, A.M. and Edith Lillian Smith, A.B. New York: Houghton, Mifflin Company, 1919. 8vo.; 416 pp.; illustrated.

The junior high school deals with pupils at a critical period, and it does not help them as much as it might. This text aims at a better preparation for the tasks which most pupils will later have to face, a better understanding of life's physical phenomena, and a definite knowledge where to go for further information as to facts and their applications. It would explore the pupil as well as the field of knowledge. To these ends it organizes details under five major topics—air, water, food, protection, and the work of the world, with a judicious selection of good illustrations.

THE DESIGN OF MODEL AEROPLANES. By F. J. Camm. London: Benn Brothers, Limited, 1919. 8vo.; 172 pp.; illustrated.

As Mr. F. Handley Page points out in an introduction, the model aeroplane has played a worthy part in solving the problems of artificial flight; it is entitled to be regarded as a scientific instrument, and the author of this work uses it as such when he shows the non-mathematical student how various models embody the theory and principles of flight, and uses these models to illustrate the functions of component parts. The construction of a full-size glider is described in fitting conclusion to a book full of interest and instruction.

TIMBERS AND THEIR USES. By Wren Winn. New York: E. P. Dutton and Company, 1919 8vo.; 333 pp.; 96 illustrations.

Great advances in metal working have not lessened the importance of wood, which may possess greater tensile strength than the same weight of wrought iron, a greater compression stress, and less deflection under load. Its elasticity, its immunity from crystallization and from rust, make it irreplaceable for certain uses. Mr. Winn's comprehensive treatise contains a list of all the known commercial woods, gives their geographical distribution, surveys the world's resources, deals with parasites and insect pests, and discusses the formation of wood and the methods of testing and seasoning timber. Ninety-six photographs exhibit the distinctive textures, and the work is a most complete guide for wood-workers, merchants, and others.

PRACTICAL DIETETICS. By Alida Frances Pattee. Mount Vernon, N. Y.; A. F. Pattee, 1920. 8vo.; 502 pp.; illustrated.

This is a manual and textbook for the use of the nurse in the classroom, and is a revised version of a work that has long taken its part in dietetic instruction. It avoids technical language, and states simply the principles of nutrition and food preparation; it supplies hospital dietaries, giving details of the most approved diets in specific diseases. The subject of food in health is not neglected, and the book should be useful in the home as well as the classroom; with it goes a booklet giving State Board requirements and State Board examination questions.

THE DOVER PATROL. 1915-1917. 2 vols. By Admiral Sir Reginald Bacon, K.C.B., K.C.V.O., D.S.O. New York: George H. Doran Company. 8vo.; Vol. I, 370 pp.; Vol. II, 346 pp.; illustrations, maps and diagrams.

The dangerous inadequacy of the strength of the Dover Patrol was a secret well-guarded from the world. Admiral Bacon tells how he and his little force, materially assisted by Admiral Bluff, policed the Channel traffic, passing 120,000 merchant vessels through the Narrows, and throwing 5,600,000 troops across the Channel without the loss of a man. We read, in a sailor's vigorous language, how one destroyer held the Straits with a dozen German ships within easy striking distance; we take part in the sensational bombardments with which this doughty little force assailed the enemy's positions; we see entirely new methods of firing and spotting evolved; portable islands are dropped as forward observing posts; a scheme for landing troops on the Belgian coast in twenty minutes, by employing 2,400-ton piers pushed by monitors and carrying tanks that in their turn pushed before them inclined ways to enable them to climb the formidable coping of the Middelkerke sea wall, was defeated only by the inability of getting land support. The fearless fisher-folk and the dauntless merchant service receive lavish praise, and certain actions of the Admiralty receive no less outspoken condemnation. The general reader, as well as the student of naval history, will find the narrative absorbing.

PACIFIC OR 4-6-2 TYPE OF LOCOMOTIVE. Educational Chart No. 12. 114 Liberty St., New York: Angus Sinclair Company, 1920. 16½ x 44.

Taking for its subject the Pacific type locomotive, this chart consists of two large detail drawings, a longitudinal and a cross sectional representation, by means of which all separate parts are shown and numbered. The remainder of the space is occupied by these numbers, in order, with the corresponding part names; the convenience and utility of this form of instruction will be at once recognized and appreciated.

A LAWYER'S LIFE ON TWO CONTINENTS. By Wallis Nash. Boston: Richard G. Badger. 8vo.; 212 pp.; illustrated.

Forty years in England, with occasional glimpses of continental life, and forty years in America, chiefly in Oregon; for English clients and acquaintances, such men as Bessemer, Spencer, Darwin, and Henry Labouchere. With such a record, we might expect these reminiscences of an octogenarian to be well worth reading and, as a matter of fact, they are. Places and people are treated of with the utmost simplicity and clarity, and we are made keenly aware of the progress of our world.

CHARTOGRAPHY IN TEN LESSONS. By Frank J. Warne. Southern Building, Washington, D. C.: Frank J. Warne. 12mo.; 159 pp.; illustrated.

Each lesson is the subject of a separate booklet, and a neat cardboard case keeps the booklets together. They constitute an elementary study of the art of charting business and social conditions, and enable the student to understand scales, build curve and bar charts, and prepare them for photographic reproduction. The necessary tools and their use, the value of statistics, and the necessity of accuracy, are among the points brought out.

ACCOUNTS RENDERED OF WORK DONE AND THINGS SEEN. By J. Y. Buchanan, M.A., F.R.S. New York: G. P. Putnam's Sons, 1919. 8vo.; 435 pp.; illustrated.

These lectures, addresses and papers embrace a variety of subjects, from the color of the sea to the daintiness of the rat. The author has had unusual opportunities, aboard the "Challenger" and other ships, to obtain oceanographical facts of significance, and his cordial relations with the Prince of Monaco have permitted the inclusion of several letters in which the royal explorer sketches incidents of his experimental cruises. There are a retrospect of oceanography, studies of the geographical homologies of the great oceans, a discussion of volcanoes and earthquakes, an account of the wreck of "Santos Dumont No. 6" at Monaco, and other papers of distinct interest.